JPRS 79695

21 December 1981

USSR Report

MATERIALS SCIENCE AND METALLURGY

No. 78

FBIS FOREIGN BROADCAST INFORMATION SERVICE

NOTE

JPRS publications contain information primarily from foreign newspapers, periodicals and books, but also from news agency transmissions and broadcasts. Materials from foreign-language sources are translated; those from English-language sources are transcribed or reprinted, with the original phrasing and other characteristics retained.

Headlines, editorial reports, and material enclosed in brackets [] are supplied by JPRS. Processing indicators such as [Text] or [Excerpt] in the first line of each item, or following the last line of a brief, indicate how the original information was processed. Where no processing indicator is given, the information was summarized or extracted.

Unfamiliar names rendered phonetically or transliterated are enclosed in parentheses. Words or names preceded by a question mark and enclosed in parentheses were not clear in the original but have been supplied as appropriate in context. Other unattributed parenthetical notes within the body of an item originate with the source. Times within items are as given by source.

The contents of this publication in no way represent the policies, views or attitudes of the U.S. Government.

PROCUREMENT OF PUBLICATIONS

JPRS publications may be ordered from the National Technical Information Service (NTIS), Springfield, Virginia 22161. In ordering, it is recommended that the JPRS number, title, date and author, if applicable, of publication be cited.

Current JPRS publications are announced in Government Reports Announcements issued semimonthly by the NTIS, and are listed in the Monthly Catalog of U.S. Government Publications issued by the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402.

Correspondence pertaining to matters other than procurement may be addressed to Joint Publications Research Service, 1000 North Glebe Road, Arlington, Virginia 22201.

JPRS 79695

21 December 1981

USSR REPORT

MATERIALS SCIENCE AND METALLURGY

No. 78

CONTENTS

TITANIUM

WELDING

MISCELLANEOUS

UDC 669.715:539.376

SUPERPLASTICITY OF AK4-1 ALLOY UNDER CREEP CONDITIONS

Sverdlovsk FIZIKA METALLOV I METALLOVEDENIYE in Russian Vol 52, No 2, Aug 81 (manuscript received 13 May 80) pp 371-376

KUZNETSOVA, R. I., MALYAROVA, T. A., POYDA, V. P., VALIYEV, R. Z. and TIMOSHENKO, Yu. B., Kharkov State University imeni A. M. Gor'kiy, Ufa Aviation Institute imeni S. Ordzhonikidze

[Abstract] Specimens of the alloy AK4-1 were heat treated and mechanically worked to produce the superplastic state, then used for tensile testing under creep conditions with constant applied stress. The specimens, deformed until failure or a predetermined degree of deformation, were quenched in water at room temperature immediately after the experiment to retain the structural state corresponding to the creep conditions. The porosity of the specimens was studied metallographically by optimal microscopy and by studying density changes. The metallographic studies showed that throughout the interval of stresses used fracture was brittle without the formation of a neck along one of a number of major cracks which appear at the moment that the specimen shifts from the first rapid stage of creep to the second slower stage or before the moment of fracture for specimens with no second stage. Photomicrographs of the surface and inner porous structure of a specimen are presented. The seemingly contradictory fact that there is no third, rapid creep stage can be explained considering the nature of superplastic flow in a porous material. The appearance of large cracks changes the stress state of the specimen. In the section adjacent to the mouth of the crack the stresses increase and go beyond the area providing optimal superplastic flow. Figures 5; references 10: 5 Russian, 5 Western.
[12-6508]

INFLUENCE OF NITROGEN ON PROPERTIES OF ALUMINUM ALLOYS

Moscow METALLOVEDENIYE I TERMICHESKAYA OBRABOTKA METALLOV in Russian No 9, Sep 81 pp 62-64

D'YACHENKO, L. I. and FEDINA, L. V.

[Abstract] One possible means of increasing the heat resistance of aluminum alloys is microalloying with refractory compounds such as nitridies. The introduction of nitrogen as nitrides increases the modulus of elasticity of aluminum. The modulus of elasticity characterizes the strength of the interatomic bond and its increase is accompanied by an increase in strength of the alloy at room and elevated temperatures. The introduction of 0.014% nitrogen to the alloys has practically no influence on hardening temperature. With 0.020% nitrogen, the kinetics of aging of D16 alloy change: the maximum hardness is achieved earlier and at lower temperature. Aging at higher temperatures reduces strength less than without nitrogen. Introduction of nitrogen to AK4-1 and VAD23 alloys has no influence on aging kinetics. Tensile testing at 20 and 150-300°C showed that alloying with nitrogen increases the strength of all alloys.
[9-6508]

SUPERPLASTICITY OF INDUSTRIAL ALUMINUM ALLOYS

Moscow METALLOVEDENIYE I TERMICHESKAYA OBRABOTKA METALLOV in Russian No 9, Sep 81 pp 58-62

RABINOVICH, M. Kh., KAYBYSHEV, O. A. and TRIFONOV, V. G., Ufa Aviation Institute

[Abstract] Conditions are determined for the transition to superplasticity of a number of industrial aluminum alloys which have similar structure though different chemical compositions. The authors have developed and tested a method of preliminary deformation and heat treatment to produce fine grained structures. It was found that the superplasticity parameters of the alloy studied are different. Considering that the microstructure of the alloys was identical before deformation, it can be concluded that the appearance of the effect of superplasticity is influenced by the chemical and phase composition of the alloys, particularly the type of antirecrystallizers. Alloys containing such transition metals as manganese and particularly zirconium as antirecrystallizers have higher maximum ductility and higher flow stress speed sensitivity factor. Working using the superplasticity effect allows achievement of homogeneous fine grained macrostructure and microstructure in commercial aluminum alloy products. Figures 4; references 12: 11 Russian, 1 Western.
[9-6508]

UDC 669.715:620.17

INFLUENCE OF IRON AND SILICON ON STRUCTURE AND PROPERTIES OF 1201 ALUMINUM ALLOY

Moscow IZVESTIYA AKADEMII NAUK SSSR: METALLY in Russian No 5, Sep-Oct 81 (manuscript received 3 Jul 80) pp 134-137

DRITS, A. M. and LEVIN, L. I., Moscow

[Abstract] Continuous casting was used to manufacture two ingots measuring 165 x 550 x 1200 mm which were homogenized at 525°C for 12 hours then rolled at 420-440°C to slabs 40 mm thick. The slabs were hardened from 535±5°C in water and aged at 175°C 18 hours (1) and 200°C 18 hours (2). The mechanical properties and fracture toughness were then determined, showing that the strength properties and relative elongation were practically independent of the content of iron and silicon, while fracture toughness and impact toughness decreased significantly with an increase in the total content of iron plus silicon, particularly in the direction of height. Increasing the aging temperature caused a decrease in both strength and ductility in both directions tested. Fracture toughness decreased in the slab with low content of admixtures, increasing slightly in the slab with higher content of admixtures. Both slabs had recrystallization structure with grain size ~60 μm. The difference in toughness properties is explained by slowing of the process of formation of the θ' phase in the alloy with the higher content of Fe and Si. Figures 2; references 6: 5 Russian, 1 Western.
[18-6508]

UDC 601.78.669.715

STRUCTURE AND PROPERTIES OF SINTERED Al-Mg-Cr ALLOY

Ordzhonikidze IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: TSVETNAYA METALLURGIYA in Russian No 3, May-Jun 81 (manuscript received 22 Feb 80) pp 115-117

BOCHVAR, O. S. (deceased) and LIKIN, V. L., Moscow Institute of Aviation Technology

[Abstract] This work presents a study of the structure and properties of hot pressed semifinished goods of Al-Mg-Cr alloy after various heat treatments, as well as a study of the possibility of great uniform deformation of specimens of this metal. Studies were performed on hot pressed bars with 180 mm in diameter of an alloy with the following composition, mass%: 9.1 Mg, 1.15 Cr, 0.86 Mn, 0.19 Ti, 1.5 Al_2O_3, remainder Al. The particle size was +100-400 μm. The mechanical properties were determined after hot pressing and annealing at 450°C for 24 hours. Temperature-speed tests were also performed. Maxima of plasticity were found in the hot pressed state at 470-500°C, after annealing the relative elongation dropped, and the optimal temperature for deformation was 450°C. The plasticity maxima indicate that this deformation temperature range is high enough to avoid grain enlargement and low enough to avoid hardening of the material. The heating time before deformation has a significant influence on the deformability of the alloy.
[178-6508]

UDC 621.793.7:621.762

PROPERTIES OF PLASMA COMPOSITE METAL-BORON NITRIDE COATINGS

Kiev POROSHKOVAYA METALLURGIYA in Russian No 8, Aug 81
(manuscript received 1 Nov 80) pp 91-96

KITAYEV, F. I. and LEKAREV, Yu. G., Kuybyshev Aviation Institute

[Abstract] The results of studies of plasma atomization of Kh20N80-BN, Ni-BN and Al-BN composites are used to analyze the influence of the composition of the atomized material, its dispersion and plasma jet parameters on the hardness, porosity and strength of the metal-boron nitride coatings, the structure of the metal matrix of the coatings, the content and distribution of the solid lubricant within them. The composite material produced is a polydispersed mixture with particle diameters 40 to 315 μm, a mechanical mixture of the metal and boron nitride in the binder of sodium silicate glass. The studies performed established the relationship between the properties of the coatings and the conditions of flow of the argon-hydrogen plasma jet. The parameters of the jet have a significant influence on the strength, hardness, open porosity and microstructure of the coatings, less influence on the quantity of solid lubricant in the material. Atomization of a finely dispersed mixture with particle diameter less than 100 μm produced a more compact metal matrix with fine grain inclusions of the boron nitride. A definite ratio between small and large particles produced the maximum values of physical properties. Regulation of the technical parameters of the process of atomization can be used to change the physical and mechanical properties of the coatings produced over broad limits. Figures 4; references 4 Russian.
[179-6508]

UDC 621.793.7:533.9

INFLUENCE OF USEFUL CONTACT AREA OF REINFORCED PLASMA COATINGS

Kiev POROSHKOVAYA METALLURGIYA in Russian No 8, Aug 81 (manuscript
received 24 Jan 81) pp 39-43

KARPINOS, D. M., ZIL'BERBERG, V. G. and IL'YENKO, A. G., Institute of Problems of Material Science, Ukrainian Academy of Sciences

[Abstract] This article deals with the further development of equations derived in an earlier article by the authors concerning the influence of the contact angle

of a flow of atomized particles with the surface of a part on the properties of the coatings thus applied. The same concept is applied to composites, and the influence of the area of shading and the limits of its change on the properties of composites to which atomized coatings are applied is studied. The equations presented can be used to select the optimal spacing for reinforcement for the manufacture of single-layer reinforced materials by atomization of the matrix onto the reinforcing fibers. The height of the atomized layer necessary for production of a material with minimum porosity following pressing is determined and a sprayer angle is selected assuring high quality application of coatings. Figures 6; references 2 Russian.
[179-6508]

UDC 621.792.4

INFLUENCE OF TEMPERATURE AND FORCE CONDITIONS OF HEATING ON STRUCTURE AND PROPERTIES OF POWDER COATINGS

Minsk IZVESTIYA AKADEMII NAUK BSSR: SERIYA FIZIKO-TEKHNICHESKIKH NAUK in Russian No 3, Jul-Sep 81 (manuscript received 19 Jan 81) pp 17-22

DOROZHKIN, N. N., GIMEL'FARB, V. N., YAROSHEVICH, G. B. and KASHITSYN, L. P., Institute of Problems of Reliability and Durability of Machines, Belorussian Academy of Sciences

[Abstract] A study is made of the stress state of bimetallic parts to determine the magnitude and direction of residual stresses and the nature of their change as a function of temperature and force conditions of application of the coatings. Studies were performed on cylindrical specimens with a 16 x 4 mm notch on the end surface, filled with self-fluxing hard alloy powder with the following composition (%): Ni, 70.61; Cr, 16.5; B, 3.62; Si, 4.2; C, 0.65; Fe, 4.42. Specimens were induction heated, then the coatings were bonded at 1155-1300°K under a pressure of 10-50 MPa. Pressure was found to be the most significant influencing effect on the bonding of the coatings. Depending on the activating pressure, increasing the temperature of bonding of the powder to 1210-1240°K resulted in practically complete relaxation of residual tensile forces. Further increases in temperature caused compressive forces to develop, reaching a maximum at 1230-1270°K, after which they decreased somewhat. The hereditary properties of the initial powder were retained most completely at 1230-1270°K, pressure 10-50 MPa. Figures 2; references 8 Russian.
[16A-6508]

UDC 621.762

PHYSICAL AND CHEMICAL INTERACTION BETWEEN FIBERS AND MATRIX DURING HOT PRESSING OF COMPOSITE ALUMINUM-BORON MATERIAL

Kiev POROSHKOVAYA METALLURGIYA in Russian No 8, Aug 81 (manuscript received 1 Nov 80) pp 63-66

SHORSHOROV, M. Kh., KOLESNICHENKO, V. A., YUSUPOV, R. S. and DRYUNIN, S. S., Institute of Metallurgy, USSR Academy of Sciences

[Abstract] A study was made of the specifics of the physical and chemical interaction between the components of an aluminum-boron fiber composite material immediately after various types of hot pressing. AD1 and D16 aluminum alloys were used, with boron fibers 100 μm in diameter without protective coating. The degree of development of chemical interaction was judged by ordinary optimal microscopy and color microscopy with interference contrast, as well as x-ray spectral analysis of the foci of chemical interaction on the surface of the boron fibers. Equations are produced for determination of the relationship between the temperature and hot pressing time required for fiber composite materials made using both aluminum alloys. Figures 4; references 7: 6 Russian, 1 Western.
[179-6508]

UDC 539.4

INFLUENCE OF LOADING MODES AND NATURE OF GAS MEDIUM ON THERMAL DEFORMATION OF CARBON FIBER MATERIALS

Kiev PROBLEMY PROCHNOSTI in Russian No 8, Aug 81 (manuscript received 12 Mar 80) pp 68-72

GRACHEVA, L. I., Kiev, Institute of Strength Problems, Ukrainian Academy of Sciences

[Abstract] A study is presented of some specifics of the thermal deformation of a carbon material--carbonized, carbon-reinforced plastic (KUP) when heated at various rates in the 20 to 1000°C interval. The thermal deformation of the KUP carbon composite material was studied in a neutral gas medium (argon) and in air at heating rates of 25, 50 and 100°C/min. The results of the study indicated extreme anisotropy of deformation properties of the carbon fiber material upon heating, which can be explained by considering that the finished material has

great porosity and a high level of residual stresses at the division boundary between each fiber and the binder. Increasing the heating rate results in an increase in the absolute value and temperature interval of expansion and a decrease in the amount of shrinkage throughout the entire temperature-time interval studied. The interaction of oxygen with the coke binder results in an increase in shrinkage of the material in the direction of the base when argon is replaced by air. Figures 3; references 7 Russian.
[3-6508]

UDC 539.4.001:678

LONGITUDINAL SHEAR CRACK IN PIECEWISE-HOMOGENEOUS ELASTIC MEDIUM

Riga MEKHANIKA KOMPOZITNYKH MATERIALOV in Russian No 4, Jul-Aug 81
(manuscript received 24 Mar 80) pp 579-584

KULIYEV, V. D. and KAPLUN, A. B., Moscow Aviation Institute imeni S. Ordzhonikidze

[Abstract] A study is made of a singular problem from the theory of elasticity for a semi-infinite longitudinal shear crack at the division boundary of two homogeneous isotropic elastic media with finite rectangular branching into a third medium. Several particular cases are studied, including a homogeneous medium and two media. The law of "refraction" of the shear crack in a two-component piecewise-homogeneous medium is formulated. References 6 Russian.
[10-6508]

UDC 539.4:678.067:624.01

CRITERION OF FRAGMENT-FREE FRACTURE OF COMBINED PRESSURE CYLINDERS

Riga MEKHANIKA KOMPOZITNYKH MATERIALOV in Russian No 4, Jul-Aug 81
(maruscript received 9 Apr 80) pp 684-688

ZAYTSEV, G. P., KOPYL, N. I., SUD'IN, V. N. and PASHKOV, V. A., Moscow Institute of Aviation Technology imeni K. E. Tsiolkovskiy

[Abstract] The pressure cylinders in life support systems are designed to burst with great difficulty and not to produce fragments in case they do burst. Combined cylinders can now be manufactured with outer shells of glass, organic, carbon or boron-reinforced plastic around a metal inner cylinder. A mathematical analysis is presented of the bursting of such a cylinder upon penetration by a foreign body and the conditions required to assure that the burst will not produce fragments. Although carbon-reinforced plastic produces the strongest cylinder, the strongest fragment-free cylinder is produced by the use of boron-reinforced plastic. Figures 3; references 5 Russian.
[10-6508]

UDC 539.4:669.71

STRESS AND STRAIN IN FIBER COMPOSITES DURING THERMAL CYCLING AND LONGITUDINAL LOADING

Moscow FIZIKA I KHIMIYA OBRABOTKI MATERIALOV in Russian No 4, Jul-Aug 81 (manuscript received 10 Dec 79) pp 101-106

YEREMENKO, V. I., BELOV, V. V. and SHORSHOROV, M. Kh.

[Abstract] A study is made of a calculation method allowing the loading and thermal cycling of fiber composites to be studied with significant radial plastic deformation gradients. Requirements are stated for the characteristics of interaction of the phases in a fiber composite. Analysis of thermal cycling in the area of elastic deformation leads to a system of three N equations with three N unknowns. The right portions of the equations contain free terms, plus the displacement and deformation, converting the system of nonlinear equations to a linear system and greatly simplifying its solution. Experimental and calculated curves agree satisfactorily. Even in composites with heat-resistant matrix there is a significant gradient in longitudinal stress in the radial direction. The actual number of linear algebraic equations which must be solved depends on the rate of plastic deformation of the matrix. Figures 3; references 4: 3 Russian, 1 Western. [180-6508]

UDC 669-494:669.7215'787;669.2965'787

MICROSTRUCTURE AND HIGH TEMPERATURE COMPATABILITY OF COMPOSITES BASED ON MAGNESIUM OXIDE AND ZIRCONIUM DIOXIDE FIBERS

Moscow FIZIKA I KHIMIYA OBRABOTKI MATERIALOV in Russian No 4, Jul-Aug 81 (manuscript received 28 Apr 80) pp 107-111

KARPINOS, D. M., LISTOVONICHAYA, S. P., GROSHEVA, V. M., MOROZOVA, V. N., DZEGANOVSKIY, V. P. and STASHEVSKAYA, I. A.

[Abstract] Results are presented from a study of the boundary interaction between a fiber and matrix plus the specifics of its microstructure as functions of the content of the reinforcing phase. Studies were performed by light and electron microscopy, x-ray phase and microspectral analysis. The nature of fracture of the composite was judged from microfractograms obtained following fractures produced in impact strength testing. Reinforcement of magnesium oxide with fibers of zirconium dioxide results in contact sections between fiber and matrix which hinder the process of formation of polyhedral structure, coalescence of pores and therefore prevents the development of slip bands and lines, thus hindering crack formation. The presence of solid solution zones at the fiber-matrix division boundary decreases the effect of reinforcement somewhat, since the division

boundary becomes more permeable for the propagation of various defects than in composites in which the fiber and matrix do not interact with each other. Figures 5; references 17: 14 Russian, 3 Western.
[180-6508]

UDC 620.22:669.71

VARIATION IN SPECIFIC CONDUCTIVITY OF FIBER COMPOSITE MATERIALS OF ALUMINUM PLUS STEEL AND ALUMINUM PLUS BORON AS FUNCTION OF CONTENT OF FIBERS, THEIR ORIENTATION AND STRUCTURE

Moscow FIZIKA I KHIMIYA OBRABOTKI MATERIALOV in Russian No 4, Jul-Aug 81 (manuscript received 31 Aug 80) pp 112-116

YATSENKO, M. I.

[Abstract] Experimental values of conductivity were determined for unidirectional aluminum-boron and aluminum-steel fiber composite materials of various structures with various angles of orientation of the reinforcing fibers and various contents of fiber. The experimental studies of conductivity were performed on flat specimens 20±0.5 mm wide, 0.8 and 1.0 mm thick and 130±10 mm long cut from a sheet material using an electric spark machine. Both composites tested were produced by hot rolling. Equations were presented for which the experimental values of conductivity agree with the calculated values within the limits of error of the experiments. Specific conductivity tests can determine the presence of defects such as cavities and porosity in the materials nondestructively, but only where the volume of the cavities and pores exceeds 2% of the total volume. If the electrophysical properties of the elements of a fiber composite are known and the conductivity is measured, the volumetric content of fibers, their orientation in the sheet material and the presence of pores and discontinuities can be judged rather precisely. Figures 2; references 8 Russian.
[180-6508]

UDC 666.223:53.54

INTERACTION OF DIAMOND WITH HARD ALLOY DURING FORMATION OF COMPOSITE MATERIAL

Kiev POROSHKOVAYA METALLURGIYA in Russian No 8, Sep 81 (manuscript received 29 Jan 81) pp 48-50

BRONSHTEYN, D. Kh., DELEVI, V. G., SIMKIN, E. S. and TSYPIN, N. V., Institute of Superhard Materials, Ukrainian Academy of Sciences

[Abstract] Systematic studies have been performed at the authors' institute, dedicated to the interaction of diamond with hard alloy matrix materials during

the formation of superhard composites. The authors studied the zone of interaction at the boundary between the diamond and the hard alloy for specimens made of VK6, VK8, VK8, VK15 and VK20 alloy with natural diamonds 500-630 μm in diameter. The area of interaction between the diamond and the matrix was studied by x-ray spectral analysis on a "microscan-5" device. The microstructure of a sintered composite was studied by a scanning electron attachment to a microanalyzer. Regardless of the type of hard alloy a zone is formed around the diamond which is rich in the cobalt phase. This zone is 4-5 μm thick. This apparently results from extraction of the more fluid cobalt phase into the free space during hot pressing. The formation of the plastic cobalt phase around the diamond grain facilitates long tool life under conditions of intensive abrasive wear and significant dynamic loading. Figures 1; references 4 Russian.
[8-6508]

UDC 669.35:539.538

INFLUENCE OF BORIDING ON STRUCTURE AND ANTIFRICTION PROPERTIES OF BRONZE-CAST IRON COMPOSITE MATERIAL

Kiev POROSHKOVAYA METALLURGIYA in Russian No 9, Sep 81 (manuscript received 30 Nov 80) pp 38-42

FEDORCHENKO, I. M., BARANOV, N. G., SLYS', I. G., VERKHOVODOV, P. A., PUSHKAREV, V. V. and SHAGINYAN, L. R., Institute of Problems of Material Science, Ukrainian Academy of Sciences

[Abstract] A study is made of the structure and antifriction properties of materials based on bronze containing gray cast iron particles. The granules were 0.63-1.0 mm in diameter; the binder was single-phase bronze, the solidus temperature of which was about the temperature of boriding of the composite material, allowing melting of the specimens to be avoided. Metallographic and x-ray analysis showed that after boriding a layer of FeB formed on the surface of the iron granules, the microhardness of which is 17.15-18.2 GPa. The depth of the boride layer was 110-120 μm. The microhardness of the bronze sections at the friction surface after boriding was unchanged at 1580 MPa. The creation of a discrete structure of fields of bronze with relatively large sections of borides is found to be an effective means for increasing the wear resistance of materials which must work in friction without lubricants. The boride sectors effectively prevent plastic deformation of the surface layers. Figures 5; references 10 Russian.
[8-6508]

UDC 620.197.3

INFLUENCE OF CLIMATIC AND STRUCTURAL FACTORS ON CORROSION OF ALUMINUM ALLOYS DURING LONG TERM TESTING IN CENTRAL AND EASTERN EUROPE

Moscow ZASHCHITA METALLOV in Russian Vol 17, No 5, Sep-Oct 81 (manuscript received 27 Feb 81) pp 499-512

SINYAVSKIY, V. S., MIKHAYLOVSKIY, Yu. N., KALININ, V. D., STREKALOV P. V., KOZHUKHAROV, V. and CHERNY, M., All-Union Institute of Light Alloys, Institute of Physical Chemistry, USSR Academy of Sciences, Scientific and Production Combine Protection of Metals from Corrosion, Bulgaria, State Scientific Research Institute for Protection of Materials imeni G. V. Akimov, CSSR

[Abstract] The AMg6M, D16T, 1915T alloys, representing various aluminum-based systems (Al-Mg, Al-Cu-Mg, Al-Zn-Mg) plus AD1M technical aluminum were used in the study. The specimens were made as plates measuring 150 x 100 mm and tested in areas with rural, industrial, seaside and steppe atmospheres in the USSR, CSSR, Hungary and Bulgaria. The corrosion resistance was evaluated basically by the depth of corrosion damage. The tests were continued for periods of up to 20 years, with samples taken from the surfaces of the specimens after 3 months, 6 months, 1 year, 2 years, 5 years and 10 years. It was found that under the conditions of the tests, thin sheets of the aluminum alloy selected were sufficiently stable. The depth of corrosion frequently does not correlate with losses of mass, and differs in its nature of change with the passage of time. Photographs of the exterior surfaces of the specimens and sectional photomicrographs of corrosion pits are shown. As time passes, corrosion slows down. Structural factors are most significant in areas where the content of acids and halides in the moisture on the metal is highest. Magnesium alloy has less corrosion resistance than any of the aluminum alloys. Figures 5; references 4: 3 Russian, 1 Western [13-6508]

UDC 621.791.011.052:620.193.2

INFLUENCE OF TITANIUM NITRIDE, CERIUM AND VANADIUM ON CORROSION RESISTANCE OF CHROME-NICKEL SURFACED METAL

Kiev AVTOMATICHESKAYA SVARKA in Russian No 8, Aug 81 pp 69-70

LAZEBNOV, P. P., SAVONOV, Yu. N., engineers, and ALEKSANDROV, A. G., candidate of technical sciences

[Abstract] A study is presented of the influence of certain modifiers (titanium nitride, cerium, vanadium) on the corrosion resistance of the chrome-nickel surfaced metal obtained by welding of 12Kh18N10T steel. Modification is performed through a calcium fluoride coating (34% CaF_2, 57% $CaCO_3$, 2% FeSi, 4% FeMn and 3% Al) by addition of finely dispersed fractions of chemically pure titanium nitride, ferrocerium (90% Ce) and ferrovanadium (35% V). Addition of 0-0.010% cerium increases the corrosion resistance of the surfaced metal in all of the media studied. Addition of 1-5% titanium nitride increases the corrosion resistance of the surfaced metal in 65% nitric acid. Vanadium modification also increases the corrosion resistance of the surfaced metal. Figures 3; references 6 Russian.
[4-6508]

FUTURE OF FERROUS METALLURGY

Moscow KOMMUNIST VOORUZHENNYKH SIL in Russian No 15, Aug 81 pp 18-23

[Article by Candidate of Economic Sciences N. Ivanov: "Horizons of Ferrous Metallurgy"]

[Text] Ferrous metallurgy is one the basic branches of industry which determine a country's economic potential. In the 11th Five-Year Plan, as noted at the 26th CPSU Congress, considerable funds are being allocated for the further development of this industry, and new, large facilities will be coming on-stream. Such attention to this branch of the economy is quite logical. Today's economy is utilizing approximately 1.5 billion tons of ferrous metals. This encompasses more than 6000 grades of steels and alloys, rolled stock, and tens of thousands of other steel and cast iron products.

In an age of swift acceleration of scientific and technological advance, metal remains the principal construction material. It serves, in figurative terms, as the material content of machinery and equipment as well as household articles. In recent years there has been an intensive search in progress for substitutes for steel, iron, and alloys. As special studies indicate, however, utilization of other materials in the economy in place of ferrous metals can increase in the immediately foreseeable future by only 4-5 percent over the current consumption figure. It is not difficult to explain the "privileged" status of metal. Its production costs are comparatively low, and it possesses unique versatility, making it possible to give products various chemical, physical and other properties, diversified shapes and dimensions. Consequently, the rate of development and effectiveness of socialist production, as well as scientific and technological advances in all branches and sectors of the economy depend in large measure on how substantial is production growth in ferrous metals, on the extent of their variety, their quality, and their cost.

The scale of development of metallurgy in this country is impressive. The Soviet Union is the world leader in production of iron ore, coke and pig iron, steel, rolled stock, pipe and tube. In spite of the fact that metal output is growing significantly, however, the economy's metal requirements are not yet being fully satisfied.

The Principal Directions of Economic and Social Development of the USSR for 1981-1985 and the Period up to 1990, ratified by the 26th CPSU Congress, focus particular

attention on growth of ferrous metallurgy. Radical improvement in the quality and increase in output of efficient products, as well as extensive adoption of advanced manufacturing processes, which will ensure a substantial decrease in the consumption of material resources at all stages of production, and priority growth of the raw materials base should become the main elements in this branch of industry.

In the 11th Five-Year Plan a large program of development of ferrous metallurgy and related branches which supply it with materials, fuel, energy, as well as modern equipment is specified for successful accomplishment of these tasks. Capital spending in this industry will increase by approximately 30 percent in comparison with the last five-year plan. Approximately one third of the total volume of capital spending will be focused on improving quality and expanding the variety of metallurgical products, while approximately 25 percent will go for renovation of existing fixed assets and technical reequipping of the branch.

It is characteristic that primarily output of efficient products will be rising at a priority rate. Production of cold-rolled sheet, for example, will almost double. This figure merits attention, for we are dealing here with quality of a product required by many branches and sectors of the national economy. Cold-rolled sheet, in comparison with hot-rolled, is characterized by better surface finish and closer tolerances, which makes it possible to save more metal.

In the new five-year plan there will be an increase in production of various rolled stock types and sections. Soviet industry will be producing economical and special types of steel pipe at an accelerated pace.

So-called powder metallurgy is highly promising. This is a most profitable method, making it possible to eliminate such traditional processes as melting and casting, and to eliminate or greatly reduce machining operations. The new technology consists essentially in the following: parts which possess unique properties are stamped of metal powders obtained by a special method. As much raw material goes into their manufacture as is needed for the finished parts. This is of great significance to the nation's economy, for metal losses are still quite substantial in this country. An average of one and a half tons of steel is expended, for example, per ton of finished steel products.

At the same time, in powder metallurgy molten metal is applied with the aid of a special technique to various parts which, acting as unique "armor," protect against corrosion, increase strength, as well as resistance to aggressive media and high temperatures. The production of every thousand tons of products manufactured by the powder metallurgy method frees approximately 200 workers, 80 metal-cutting machine tools, 5000 square meters of production space, saves almost 2500 tons of rolled steel and nonferrous metals, and saves approximately 1.5 million rubles.

We are dealing here with a very substantial scientific and engineering leap forward. Equipment already exists which enables us to atomize metal into the tiniest granules, and equipment has been developed for compression molding these particles. It is important that series manufacture of such equipment commence at the earliest possible time and that the production of powders be concentrated within one source.

Industrial production of precision (particularly high-strength and pure) alloys and rolled stock, which possess magnetic, electrical, thermal and other properties, determined by the exactness of chemical composition, absence of impurities, and careful processing is developing more intensively in the new five-year plan.

In coming years ferrous metallurgy is called upon to play an important role in reducing product materials requirements and in achieving savings in raw materials and supplies. This will also promote improving the efficiency of the economy. Coke consumption in blast-furnace production, and pig iron consumption in steelmaking shops will diminish, for example. Employment of advanced technology will reduce steel consumption per ton of finished rolled product.

In the 11th Five-Year Plan the metallurgical industry will create the necessary conditions for reducing in machine building and metalworking standard consumption figures by not less than 18-20 percent on rolled ferrous metals, and by 10-12 percent on steel pipe.

Employment of new kinds of rolled products also involves extending product service life. And this means continuing in the future to reduce metal requirements for their manufacture. One ton of heat-treated rails, for example, provides the possibility of saving half a ton of steel. Plate and sheet coated with nonferrous metals and polymers have their service life extended by 50 percent.

The period 1981-1985 will be distinguished by extensive technical reequipping of metallurgical enterprises. Equipment unit output will increase, and new manufacturing processes will come solidly on-stream. Numerous facts attest to the effectiveness of this work. An increase in the net volume of blast furnaces from 3200 to 5000 cubic meters, for example, produces a labor productivity increase by almost one third and reduces specific capital expenditures by 12 percent.

Such ferrous metallurgical enterprises as the Magnitogorsk Combine, the Krivoy Rog, Zhdanov, Cherepovets and Lipetsk plants are among the world's largest as regards concentration of production. We shall note that in 1980 Magnitka produced approximately 16 million tons of steel, and the Krivoy Rog Plant -- more than 12 million tons. These two enterprises together produce more steel than all of France or Italy.

The degree of concentration of the metallurgical industry in the USSR will increase to an even greater extent during the current five-year plan as a result of bringing new facilities on-stream, renovation and partial retirement of obsolete facilities.

Intensification and production efficiency in the iron and steel industry depend in large measure on the degree of development of the iron-ore base, the extent of employment of advanced technology in surface mines, underground mines and at mining and concentration combines. The industry's raw materials base will be ensured priority growth during the 11th Five-Year Plan. In particular, the goal is more efficient recovery of various constituents from the mined ores.

An increase in production will become possible through the all-out employment of advanced industrial methods. Electric steel production, for example, will increase by 60 percent, while plans call for increasing the percentage share of

oxygen-converter steel from 28.5 to 33 percent. This would seem to be a small increase -- of about 5 percent. But at the scale of today's metallurgical industry, such an increment amounts to millions of tons of metal.

Continuous casting of steel will experience further development in 1981-1985. This is a highly economical and efficient method of producing basic ingots. This method makes it possible to achieve savings of up to 12 percent of total metal and to increase its uniformity and strength. More than 11 percent of total steel produced is currently being poured by this method. It is true that in this area we still lag behind the most developed capitalist countries. This gap will narrow appreciably in the new five-year plan. In 1985 continuous-casting steel production in the USSR will total 35-37 million tons, or almost twice as much as in 1980.

A large steelmaking shop has been built at the Novolipetskiy Metallurgical Plant, which represents a world first. There are no pouring channels, and all steel is produced by the continuous casting method. This shortens the production cycle. It is no longer necessary to "strip" ingots or to erect large roughing mills -- blooming and slabbing mills -- which, as we know, requires considerable capital investment. Operating expenses are also reduced at the same time. At the Novolipetskiy Metallurgical Plant consumption of ingots in producing rolled stock is significantly lower than at other enterprises turning out a similar product mix but operating by the traditional technology.

Vivid evidence of the continuous scientific and technological advances in this industry is construction of the Oskol Electrometallurgical Combine. A totally new technology is characteristic of this facility. At this combine steel will be made directly from metallized pellets -- small bits of finely crushed ore and concentates obtained by the direct reduction of iron (bypassing the blast furnace).

Producing metals from pellets solves a very acute problem of world significance, connected with the rapid exhaustion of reserves of coking coal, without which, as we know, blast-furnace production is impossible. The development of cokeless metallurgy will accelerate due to the extensive utilization of the experience which will be obtained from construction and operation of the Oskol Combine. This will be the first enterprise which will produce on a large scale steel containing fewer impurities and possessing excellent mechanical properties. This steel is extremely valuable. Its utilization in the nation's economy will extend the service life of machinery and structures and will make it possible to manufacture high-strength pipe and metal products. Oskol steel will be indispensable in the manufacture of equipment designed to operate in the conditions of the Far North.

In the new five-year plan it will also become possible to improve production efficiency in the steel industry through combining metallurgical plants with nuclear-industrial complexes. In this "alliance," the heat generated by high-temperature nuclear reactors is utilized not only to generate electric power but also to obtain reducing-agent gases from solid, liquid and gaseous fossil fuels, and in the future from water as well. Such gases are extensively employed in a number of branches and sectors of the USSR economy. In the metallurgical industry they can be employed in sintering, coke and blast-furnace operations, and in the direct obtaining of iron.

Electrolytic processes will experience comprehensive development. So-called volumetric electrolysis will increase the rate of these operations severalfold. This technical innovation will make into a realistic possibility the construction of plants which will utilize all ore constituents for producing steels and alloys of a preselected composition in the form of powders and subsequent manufacture of sheet, plate and sections by direct rolling, and metal products by the molding technique.

An improvement in the technological level of metallurgical production also depends to a decisive degree on continuous renewal of fixed assets. In the period 1981-1985 there will be an increase in the percentage share of capital spending on new equipment, with a gradual decrease in expenditures on renovation, and there will also be a decrease in expenditures on reproduction of obsolete equipment. More than two thirds of appropriations allocated to ferrous metallurgy are to go for completion of facilities on which construction is in progress, as well as construction of new facilities, which will go into production during the current five-year plan.

The 3000 mill at the Zhdanov Plant imeni Il'ich, a strip shop at the Magnitogorsk Combine and a thin steel sheet shop at the Karaganda Combine, an oxygen-converter shop at the Plant imeni F. Dzerzhinskiy, electric furnaces at the Kuznetsk and Orsk-Khalilovo combines, as well as other facilities will come on-line in the first years of the five-year plan.

Improvement in production efficiency in the metallurgical industry is being promoted by further automation of production and management. For example, a metallurgical production automated management system is being developed. It will operate within the framework of the Uniform State Network of the automated system of management of the national economy. Its principal task is long-range development planning for this branch, preparation of current production plans taking into account this country's economic and social growth, and monitoring of execution of planned measures.

Practical adoption of the latest and most diversified equipment will more significantly help mechanize laborious and monotonous jobs, especially in auxiliary areas of the production chain.

The problem of efficient utilization of secondary energy resources is more acute in ferrous metallurgy than in other branches of industry. We shall also state that a better job of solving this problem is being done in this industry. This will be particularly noticeable in the 11th Five-Year Plan. In general it is easy to explain the fact that ferrous metallurgy is leading the other branches. Where are secondary energy resources more substantial than in this industry? Efficient utilization of such resources saves millions of tons of fuel. These resources are concentrated at large enterprises, where their utilization is especially efficient. To that we shall add that ferrous metallurgy is distinguished by a specificity of production processes, which take place at high temperatures. All this offers a good opportunity to recover and utilize waste heat with maximum effect.

The Novolipetskiy Metallurgical Plant offers a persuasive example. At this plant removal of gases has doubled the intensity of converter blowing and has increased the productivity of one of the shops by 20 percent with minimal equipment renovation. In the open-hearth shop of the Zaporozhstal' Plant, there has been a substantial decrease in consumption of refractories, and equipment downtime has been reduced.

A system of evaporative cooling of metallurgical equipment has come into widespread use. In the Soviet Union it has been adopted on more than 500 installations. This system has been highly praised by companies in the United States, the FRG, Japan, Austria, France, Belgium, Italy, and Canada, which have obtained licenses for it.

Intensive development of the metallurgical industry also presupposes environmental protection and improvement -- the air and water, and efficient utilization of all natural resources. An entire aggregate of projects, for example, is specified for assuring clean air. The aim of these projects is to create health-protective zones, to reduce industrial discharges into the atmosphere to the greatest possible degree, etc. Blast furnace No 9 at the Krivorozhstal' Plant, the world's largest, is furnished with powerful and effective equipment for treating waste gases and a closed-cycle water supply. At the Magnitogorsk Metallurgical Combine construction of equipment to trap sulfur has reduced discharge of sulfur dioxide into the atmosphere by 60 percent, while discharge of particulates has been decreased fourfold. At the Makeyevka Metallurgical Plant all open-hearth furnaces are outfitted with gas-scrubbing equipment. The result has been an appreciable improvement in air quality around the plant and in the city.

Of course projects connected with environmental protection require large capital spending. In some instances these expenditures comprise one fourth of the total cost of the various shops and production facilities. Nevertheless such expenditures are essential. They help not only eliminate sources of pollution but also help reclaim for useful purposes acreage covered by slag heaps, settling basins, etc, protect the environment, and maintain good environmental conditions for Soviet citizens.

Many other responsible tasks also face metallurgical workers, whose labor is deservedly respected in this country. The work performed by men of the "fiery profession" presupposes not only fortitude and stamina but also profound knowledge and a high degree of skill. It is drawing increasingly close to the labor of engineers and technicians. This is why metallurgists show an endeavor constantly to increase their knowledge, to learn the finer points of their profession, and work hard to master the new technology engendered by rapid scientific and technological advances. The workers of this industry are enrolled at general-curriculum secondary schools, secondary technical schools and higher educational institutions, as well as at numerous schools of advanced know-how.

Much is being done to improve working conditions for metallurgical workers and to make them safer, to improve living conditions and recreational opportunities, and to provide better medical care. Each year approximately 1.5 million square meters of housing is completed for tenancy by metallurgical workers. Every year one out of every four metallurgical workers receives medical treatment and rest at sanatoria, guest houses, and plant preventive clinics.

Responding to the concern of party and government, ferrous metallurgical workers are laboring selflessly, utilizing in full measure to achieve a further upswing of this branch of industry such a powerful force as socialist competition. Many outstanding initiatives have been born through the energy and innovativeness of the masses. Competition leaders persistently seek ways to achieve more efficient utilization of the powerful equipment which our state so generously furnishes this industry.

The names of production innovators, who give the homeland and our nation's economy high-quality metal, are well known throughout the country. Socialist competition leaders include thousands of war veterans and reserve military personnel. Qualities acquired in the army and navy -- industriousness, courage, discipline, and ideological maturity -- help them carry out their patriotic duty in a worthy manner at major ferrous metallurgical plants and help them value and cherish worker honor.

This year metallurgical workers are to produce 156.8 million tons of steel, 109 million tons of finished rolled stock, and 18.5 million tons of steel pipe. This is a large step forward in development of this branch. There is no doubt that these ambitious figures will be achieved. Many metallurgical work forces have amassed valuable experience in the campaign for utilization of reserve potential for improving efficiency and quality. This is vividly manifested in the course of the nationwide competition for successful fulfillment and overfulfillment of the targets of the 11th Five-Year Plan.

Party organizations constitute a great force in this branch. Communists serve as leaders of all good initiatives at plants and combines, display an example of selfless labor, and lead the masses in socialist competition under the slogan "Work efficiently and with high quality!" Party organizations are concentrating their attention on improving organization and order in production, are waging a resolute campaign against violations of labor and process discipline, and are guiding people's efforts toward a uniform flow of output of high-quality products which strictly meet specifications. They disseminate advanced know-how of metallurgical workers and raise the masses to achieve successful fulfillment and overfulfillment of the targets of the new five-year plan. Ferrous metallurgical workers, headed by their Communist right-flankers, are filled with resolve to implement the plans of the 11th Five-Year Plan and the historic resolutions of the 26th CPSU Congress.

3024
CSO: 1842/174

RATIONAL WASTE METAL UTILIZATION URGED

Moscow SOTSIALISTICHESKAYA INDUSTRIYA in Russian 17 Oct 81 p 2

[Article by Candidate of Economic Sciences S. Yaroshevskiy, Moscow: "Putting In-Process Waste to Work"]

[Text] I have been following very closely materials published in the newspaper under the heading "Metal: Where and How It Is Lost." I should like to share my thoughts on this matter.

For a long time metallurgical plants suffered from a shortage of complex-configuration rolls. For this reason bending-shaping units frequently stood idle, and production of advanced rolled products would halt. Metallurgical industry customers would rant and rage at the roll suppliers. They would always receive the same reply: we are short of forgings and castings.

A team of experts found a solution, proposing that they employ in the manufacture of the components of such rolls waste metal generated... at those same machine building enterprises. Practically no additional expenditures would be needed. In addition, the supplier earns 1500 rubles net profit per ton due to the difference in prices on scrap and finished product. As a result, the problem of bend-shaping rolls has now been fully resolved.

Unfortunately, examples of this kind are a rare exception in our business practices. On the whole the problem of efficient utilization of commercial waste metal is far from solution. Here are a few randomly selected facts.

The Krivorozhstal' Metallurgical Plant puts out a highly varied product line: wire, rod, round and square section rolled stock, periodic rolled stock, and other merchant-mill products. Every year tens of thousands of tons of such metal, rejected for "geometry" or other reasons, are cut up into 1-meter lengths and returned to the open-hearth furnaces. At the Novolipetskiy and Cherepovets Metallurgical plants sheet rejects and waste are compressed into bales and shipped off for remelting. Every year pipe and tube plants send off hundreds of freight cars loaded with full-length reject pipe sections. They are hauled to scrap breaking shops and to Vtorchermet plants, where they are cut, compacted, and sent off to be remelted.

This is not a new problem. But that by no means lessens its acuteness. SOTSIALISTICHESKAYA INDUSTRIYA was correct in statements made in an article entitled "To Find, In Order... To Lose" (8 August of this year): the attitude toward in-process waste metal is in contradiction with the policy of all-out economy of material resources specified at the 26th CPSU Congress. It is not enough, however, merely to state the present unsatifactory situation in this area. It is much more important to analyze the causes.

About 20 years ago a document came out prohibiting the scrapping of waste metal which can be used for the manufacture of consumer goods or other in-demand manufactured goods. Since that time rolled metal production has almost doubled in this country, with a corresponding increase in waste metal, and new technical capabilities for utilization of this metal have been developed. The total quantity of in-process waste metal subjected to recycling, however, has remained unchanged.

What is the problem? Could it be that no more is required? A great many facts indicate that this is not the case.

In Sverdlovsk, where I was employed as chief engineer of the oblast Vtorchermet, construction people came to us to ask our help in obtaining production-reject rails: it was necessary to lay several branch streetcar lines running from worker districts in the outskirts to the downtown area. Their request approved, the construction people sent several workers and a truck-mounted crane to the local Vtorchermet plant, where they found rails, joint bars, and tie plates -- a total of approximately 3000 tons. Anyone who visits Sverdlovsk can ride a streetcar on tracks built of... scrap metal.

I recall another incident, which took place in Moscow. A representative from a Khar'kov enterprise dropped in with a request: "Help us solve a problem. We process industrial diamonds and have decided to utilize the diamond dust which is produced." He took a nail file out of his pocket. It was a strip of stainless steel about 8 centimeters in length and approximately 1 centimeter wide. A thin layer of extremely fine diamond chips had been applied to both sides. Everything was ready for mass production -- process, equipment, and basic material, but they could not obtain steel strips anywhere.

I asked where he had inquired on this matter. He showed me dozens of letters and replies to them. He had been knocking on various doors for more than a year. And everywhere he was turned down, although many thousands of tons of stainless steel scrap are shipped off for remelting. We immediately wrote up an order for 2 tons of stainless steel scrap to be shipped off to that enterprise. Soon that diamond file was on the market. It is in great demand.

There is no doubt whatsoever that utilization of waste metal can be greatly increased. But the question of whether this will be accomplished in the near future is much more difficult to answer, and here is why.

We are lacking at the present time a uniform, clear-cut system of recovery and utilization of in-process waste metal. Nor is there an organization with a vital interest in resolving this important problem. The quantity of waste metal utilized without remelting reflects the old, traditional links between customers

and suppliers. Nobody is working on obtaining additional co-production.

Soyuzvtorchermet is responsible for the collection, processing and marketing of scrap metal. In addition, it conscientiously supplies industry each year with 500,000 tons of in-process waste metal for the manufacture of various products; no less, but also no more, since it is targeted precisely with this figure by USSR Gosplan. An additional approximately 2 million tons of waste metal is utilized at enterprises on the basis of Soyuzglavmetall supply orders. This makes it possible to return to useful consumption not more than 4-5 percent of total steel waste. The rest is returned for remelting.

At the present time essentially nobody is seriously working on the problem of recovery of in-process waste, ferrous and nonferrous metals production rejects. Nor is anybody seriously studying resources of and demand for this waste metal, or planning utilization of waste metal taking these factors into account. Of course there is no need to explain that this situation cannot be considered normal.

What must be done to put things in order? First of all it is necessary to have a clear idea of the variety and quantity of initial stock employed in machine building and construction. It is also necessary to know the variety and dimensions of rolled metal waste generated at metallurgical enterprises. These figures should be listed in catalogues, from which it would be easy to determine in what instances it is feasible to substitute in-process waste for finished rolled products.

But information alone is not enough. It is essential to provide both manufacturers and customers with the most favorable conditions for achieving their goals. For example, today a metallurgical plant can supply a certain quantity of waste for sale to the public. But it has no authorization to do so, although demand for rolled metal products for private construction of housing, vacation cottages, garden plots, etc, is considerable.

As a rule, however, metal is still found for these purposes. Where? Enterprises release some of it to their employees, officially designating it "substandard." A good deal of metal falls into private hands illegally, in transactions which profit dishonest individuals. Is it not better to give plants the opportunity to sell in-process waste metal by direct contracts through trading organizations?

Prices can become an important incentive for more extensive utilization of waste metal. If, for example, a customer needs pieces of metal shorter in length than specified by the standard for finished rolled product, sale of such pieces should be at a higher price. This is beneficial not only to the supplier but to the customer as well: he will expend fewer material and labor resources on cutting metal.

Obviously other suggestions can be made in the same vein. One thing is obvious: an entire package of measures is necessary, a specific procedure of recovery of in-process waste metal established for all industries. Elaboration of such a package of measures will require the joint efforts of specialists from all-union Gosplan, Gossnab, Gosstandart, the State Committee for Prices, and branch ministries. Let us calculate what this can generate.

At the present time we return for remelting each year approximately 55 million tons of so-called "fresh" waste metal, that is, metal which was never consumption-utilized (including machining chips). In principle the greater part of this waste can be utilized in one way or another, for we need not only large-size machine parts but also various washers, gaskets, springs and other small metal items, right down to paper clips.

Let us set for ourselves, however, a modest task -- to utilize only 10 percent of the waste rolled steel returned for remelting. This is a quite realistic task. According to the most conservative estimates, this could result in savings of 4-4.5 million tons of metal annually.

I foresee the following question: what can be used to replace that waste metal which is now going into scrap? The answer is that our economy possesses enormous reserve potential for additionally tapping 25-30 million tons of metal contained in slag piles at metallurgical and machine building plants.

Twenty-five years ago this country was recovering each year approximately 3 million tons of metal from slag heaps. Today, when three times as much slag is being hauled to these dumps, slightly more than 2 million tons of metal is being recovered. Nor is the metal hauled to the slag piles figured on an enterprise's balance sheet.

And yet the practical experience of past years convincingly demonstrates that an area equipped with an excavator, two magnetic separators, a bulldozer, two truck-mounted cranes and three dump trucks can recover from the dump 50,000 tons of scrap per year. Dozens of such operations could be set up at this industry's plants. Metal obtained from slag heaps corresponds by chemical analysis to that metal which is produced by the given plant. Specific capital investment on its recovery is 20 to 25 times less than to produce pig iron, taking adjacent operations into account.

Working of slag piles can more than cover the shortage of scrap metal which can occur with fuller utilization of waste metal. We should bear in mind that we are dealing here with putting several million tons of rolled metal to use. The potential benefits make it worthwhile to address this matter seriously.

3024
CSO: 1842/29

UDC 621.74.043.984:669.715.002.6

INCREASE IN DENSITY OF THINWALL ALUMINUM CASTINGS POURED UNDER LOW PRESSURE INTO CERAMIC MOLDS

Moscow LITEYNOYE PROIZVODSTVO in Russian No 3, Mar 81 pp 10-11

KUSHKA, N. K., engineer, and CHERNEGA, D. F., doctor of technical sciences

[Abstract] The change in gas content in a melt poured under low pressure was studied by vacuum heating of AL9 alloy in 5-layer ceramic molds on a casting machine. Analysis of the change in gas content and of the microstructure of the castings indicated that in spite of an increase in the quantity of hydrogen in the furnace metal the parts were still compact, since little gas is liberated from the metal under the slight excess pressure and with the rapid cooling rates used. The studies also showed that the gas content of castings higher in the machine was 10 to 12% higher than that of the lowest castings. The transition to low pressure casting of thinwall parts reduced the reject rate due to leaks after mechanical working from 50-60% to 8-10%. Figures 2.
[27-6508]

UDC 621.74.002.6:669.15.24

INFLUENCE OF DECARBURIZATION PROCESS ON HEAT RESISTANCE OF CHROMIUM-ALUMINUM CAST IRON

Moscow LITEYNOYE PROIZVODSTVO in Russian No 3, Mar 81 pp 6-7

VOZDVIZHENSKIY, V. M., doctor of technical sciences, KONONOV, V. A., KONONOVA, Ye. V. and KARPOV, V. L., engineers, Rybinsk Institute of Aviation Technology

[Abstract] A study was made of the heat tolerance of chromium-aluminum cast irons with 2.5-3% C, 2.2-2.53% Si, 0.7-0.8% Mn, 0.04-0.06% S, 3-7% Cr, 0.05-0.08% P and 1-5% Al, melted in an acid induction crucible furnace and poured at 1400-1420°C, checked by a W-Re thermocouple. The scale resistance and decarburization were determined in 150 hr tests at 750°C. Oxidation involves two competing processes: decarburization and oxidation of the metal matrix. Decarburization predominates during the first hours of high temperature holding. It is found that an increase in Cr content in the cast iron from 3 to 7% results in an increase in heat tolerance both by influencing the formation of a protective oxide film and by decreasing the quantity of free carbon, reducing decarburization. Figures 2.
[27-6508]

GOLD-MINING TECHNOLOGY ON KOLYMA

Moscow SOTSIALISTICHESKAYA INDUSTRIYA in Russian 27 Sep 81 p 1

[Article by MAGADANSKAYA PRAVDA correspondent A. Gershevich, Magadanskaya Oblast: "Gold 'Harvest'"]

[Text] Off in the distance, from the top of the last of the three ridges which separate the Shturmovoy Mine from the Kolyma Road, one can spot the sparkling gleam of rainbow-hued jets of water down in the valley. They are powerful hydraulic-mining water jets, pounding against piles of gold-bearing rock. In order to obtain significant extraction of the dull yellow concentrate, it is necessary to excavate entire mountains of ancient fluvial sediments from under a permafrost layer several meters thick, after which the rock must be moved to a processing site and washed by hydraulic-mining water jet.

This operation can be accomplished only with powerful excavating equipment, explosives, and the skill of the human operators. It is for good reason that the gold miner's labor has traditionally been called a mining art. It is based on a wealth of experience and know-how, scientific calculation by engineers and economists, inexhaustible worker intelligence and comradely mutual assistance.

The fact that the Shturmovoy miners have these qualities in full measure is indicated by a school of advanced know-how for specialists employed at neighboring gold-mining operations, a school set up at the peak of the busy season at the Shturmovoy. The high-output hydraulic-mining units -- fruit of the cooperative alliance of worker innovators and engineers -- were first put into operation in the placer mining areas of the Shturmovoy, and from there proceeded to other mines of the Yagodinskiy Mining and Concentration Combine -- Burkhala, Pyatiletka, imeni Gor'kiy, and imeni Berzin. These units have doubled labor productivity.

I joined the participants in the school and became acquainted with one of these units. The first thing one notices is the absence of bulldozers to feed the rock. This operation is handled by 27-ton dump trucks. Three BelAZ trucks shuttle back and forth from excavator to the unit's feed hopper, operating night and day. In a 24-hour period the unit washes between 1500 and 2000 cubic meters of rock.

There is another version of transfer arrangement for moving rock to the washer unit. In place of the BelAZ trucks, eight-cubic-meter scraper-excavators proceed out to the placer area. A conventional piece of heavy road construction equipment, which

the Shturmovoy people have successfully adapted for mining operations. It loads itself with the aid of a pusher-tractor. Closing its steel-bucket jaws, the scraper heads for the washer unit.

All these things are visible signs of the retooling which took place on a large scale in the 10th Five-Year Plan. The Kolyma miners have received and are continuing to receive the most modern Soviet and imported equipment. The task consists merely in utilizing it with maximum efficiency. The Shturmovoy miners demonstrate with their successful operation how this can be achieved. Emphasis is placed primarily on Soviet-built equipment: this guarantees high-efficiency and dependable operation.

Take Yakov Ugryumov's brigade, which is a leader in the current mining season. Month after month it is surpassing its targets pertaining to volumes of rock washed, stripping and, as a consequence, gold production. It is not only a matter of equipment, however. The combine's other brigades are equipped equally well, but their successes are much more modest. The secret, states mining foreman A. Mostovoy, lies in the fact that the work force skillfully utilizes all the advantages of the brigade contract. A prestigious brigade council has been established, and each month the labor participation factor is determined for each of the 45 miners. This has boosted labor discipline, responsibility, has made competition more graphically palpable, and has developed initiative in the workers. Equipment idle time has been sharply reduced, and the men are working with eagerness and enthusiasm.

Yes, the brigade contract is also making increasing inroads in the placer mining areas. At the present time 18 brigades and three surface-mining sites are utilizing this advanced method just in the Yagodinskiy Combine. But the contract is still a new thing in this branch. Thus the know-how learned by the school participants from Ugryumov's brigade is particularly important. This experience is proof that sophisticated equipment requires sophisticated forms of utilization and organization of labor, for the fate of the gold "harvest," as each new hydraulic mining season is called on the Kolyma, is determined in the final analysis by human operators, by their labor enthusiasm and dedication to their difficult job.

Visiting the combine's enterprises at the height of this year's mining season, I encountered such people everywhere. The majority of these individuals have long been well known among the miner collectives. At the Burkhala mine, for example, the work force has been headed for 16 years now by G. Sumenkov, a veteran of the Far North. And the miners at this remote mining operation are overfulfilling their plan targets and pledges for the 16th mining season in a row. And as regards the combine as a whole, two brigades, one stripping operation, and several prospector cooperatives have already completed this year's targeted figures and are producing above-target gold. And yet this year's mining season has been difficult. A two-month hot spell without any rain resulted in taiga forest fires, combating which required the diversion of large quantities of mining equipment. Dried-up creeks and streams made it necessary to conserve water and to "bring it in" from a distance. But there is also another distinctive feature of this year's mining season. It is a "golden" year -- it was 50 years ago that the government began mining gold in the far Northeast.

The gleaming yellow metal does not come easily. It becomes increasingly more difficult to work as fall draws nearer. Therefore all manpower and equipment, all the experience and know-how of the miners are today focused on a single thing -- to work more successfully, to process as much rock as possible! For very few warm, fair-weather days remain, and every such day here is cherished as only Northerners know how.

3024
CSO: 1842/16

INFLUENCE OF HEATING TEMPERATURE FOR HARDENING ON MECHANICAL PROPERTIES OF KhN56VMTYu ALLOY

Moscow METALLOVEDENIYE I TERMICHESKAYA OBRABOTKA METALLOV in Russian
No 9, Sep 81 pp 43-44

OSTROVSKIY, L. S. and MIRONOVA, G. V., Kulebaki Metallurgical Plant imeni S. M. Kirov

[Abstract] The heat treatment used for KhN56VMTYu alloy, hardening in air from 1200°C (1 hour), does not provide a sufficiently high and stable level of short-term strength at 20°C. Hardening in air from 1150°C (1 hour) was tested and found to produce short-term strength at 20°C, while hardening from 1200°C produced no further increase in short-term strength, but relative elongation was significantly higher after hardening from 1150°C. This results from the fine grain structure of the metal achieved.
[9-6508]

UDC 669-1

INFLUENCE OF HEAT TREATMENT ON PROPERTIES OF SILICON-GERMANIUM ALLOY CONTAINING ALUMINUM

Tbilisi SOOBSHCHENIYA AKADEMII NAUK GRUZINSKOY SSR in Russian Vol 102, No 3, Jun 81 (manuscript received 5 Sep 80) pp 649-652

KEKUA, M. G. and PAGAVA, M. O., Georgian Academy of Sciences, Institute of Metallurgy imeni the 50th Anniversary of the USSR

[Abstract] Results are presented from studies of the influence of heat treatment at 1000°C on the microstructure, the microhardness and electrical properties of the alloy $Si_{0.85}$-$Ge_{0.15}$ as a function of the quantity of aluminum present (0.15-9.6 at .%). The specimens were cut from crystals produced by drawing from a large volume of melt in a medium of helium at 1.5 atm pressure. The specimens were etched in boiling 25% potassium alkali containing several drops of perhydrol then washed several times in boiling distilled water, placed in evacuated quartz ampules and heated in a resistance furnace to 1000°C, then held at this temperature for 2 weeks to achieve equilibrium, after which the ampules were quenched in water. The specimens were studied before and after heat treatment. Heat

treatment resulted in a decrease in the concentration of holes in all specimens and a corresponding change in conductivity. The solubility of aluminum was found to decrease after heating to 1000°C. The alloy containing large quantities of aluminum undergoes redistribution of the aluminum atoms at 1000°C, the excess aluminum leaving the matrix and forming a separate phase, thus decreasing the concentration of charge carriers and increasing the microhardness of the alloy. Figures 3; references 9: 3 Russian, 6 Western.
[20-6508]

FULLER RECOVERY OF SHORT-SUPPLY METALS FROM ORE URGED

Moscow PLANOVOYE KHOZYAYSTVO in Russian No 8, Aug 81 pp 111-115

[Article by A. Savin, sector chief, NIItsen: "Comprehensive Utilization of Metallic Ore Raw Materials and Pricing"]

[Text] Mining and production of metals, which comprise approximately 80 percent of all the elements in the periodic table, as well as the degree to which a nation's economy is supplied with metals constitute one of the principal components of a country's economic and scientific-technological potential. Such metals as iron, aluminum, copper, titanium, zinc, lead, nickel, chromium, tin, magnesium, manganese, and their alloys comprise the principal structural as well as chemical materials of industry. It does not appear possible to replace them to a decisive extent, at least in the near future. Such metals as germanium, rhenium, gallium, rhodium, cerium, selenium, rubidium, indium, niobium, zirconium, cesium and others which are rare in natural occurrence have also acquired great practical significance.

The present stage of development of production throughout the world is characterized by aggravation of the problem of reserves and efficient utilization of all material resources in general and natural resources of metallic-ore raw materials in particular. This also applies to our country to a certain degree, although it possesses great natural riches.

L. I. Brezhnev stated the following in the Central Committee Report to the 26th CPSU Congress: "Obviously we must also approach the extractive industries as a whole in a new way.... The success of the entire nation's economy will depend in large measure on improving the efficiency of the extractive industry. The way to achieve this includes acceleration of scientific and technological advances, comprehensive, thorough processing of commercial minerals, and more extensive utilization of secondary resources.

"The importance of these tasks is connected with the fact that we are dealing here with non-renewable resources."*

This problem is complicated to a considerable degree by the enormous scale of mining and processing of mineral raw materials, by the difficulty of finding new ore bodies,

* "Materialy XXVI s"yezda KPSS" [Proceedings of the 26th CPSU Congress], Moscow, Politizdat, 1981, page 41.

and by worsening mining-geologic and geographic conditions of occurrence and commercial exploitation of ore raw materials, by a lowering of ore grade, and by increased expenditures connected with ore utilization (including transportation). For example, the degree of extraction of iron (in merchantable ore) is characterized by a steady decline as low-grade and difficult-beneficiation ores are brought into production: 83 percent in 1970, 82 percent in 1975, 80.8 percent in 1979, and 80.7 percent in 1980. As a consequence of this, the requisite quantity of iron for producing pig iron was obtained by increasing the physical volume of ore mined and concentrated. In practical terms this means that such a large mining and concentration combine as the Kovdor is working entirely on compensation for losses caused by a decline in the coefficient of ore extraction into concentrate. In nonferrous metallurgy, for example, a decrease in reserves of high-grade bauxites was compensated for with higher-volume processing of ore with a lower alumina content than bauxites -- nephelines and alunites, etc. As studies indicate, in coming years metal content in ferrous and the majority of nonferrous metal ores will decrease by an additional 10-15 percent.

Countering the decline in natural grade of mined ores is increased concentration of recovered metals in merchantable ore and ore concentrates and intermediate products as a result of beneficiation and processing of the raw ore. For example, iron content in merchantable ore (dry weight) increased by 1 abs.% in 1980 over 1970, while recovery of zinc from lead-zinc and sulfide ores during this same period increased by an average of 2 percent, 4 percent for lead, 10 percent for nickel from lead-nickel ores, and 2.5 abs.% for copper from copper and copper-zinc ores.

Attaining a greater metal content in merchantable ore and concentrates, however, requires increasingly larger additional expenditures connected with improving ore preparation, extensive adoption of deep concentration processes for low-grade ores, increased depth of ore body working in underground mining, and an increase in the overburden ratio in surface mining operations. The increase in additional expenditures for iron ore, for example, was approximately 12 percent in 1980 as compared with expenditures on producing merchantable ore in 1975.

In connection with the increasing scarcity of resources of many types of raw ore with an increase in the economic significance of finding these ores and organizing their efficient utilization, in our opinion one should distinguish between two terms: the economic and the natural (physical) limitedness of a given natural-resource raw material.

In our opinion economic limitedness reflects an inadequate volume of resources actually drawn into the process of their industrial consumption and processing. For example, nickel ore and the metal nickel, aluminum and a number of others are short-supply resources in an economic sense. This cannot be stated absolutely, however, for we know that great physical masses of these metals exist in the chemical composition of our planet.

In addition, the economic limitedness of raw ore resources is predetermined by the conditions and scale of discovery, mining, processing and commercial utilization of recovered metal in a given period of time. Of decisive significance among these conditions is the existence of proved commercial reserves of raw material, the level of equipment and technology of its processing, and the magnitude of direct and associated expenditures on obtaining the end product -- metal.

The overwhelming majority of ores mined in the Soviet Union are complex ores. Iron ores, for example, in addition to iron, contain vanadium, zinc, cobalt, germanium, phosphorus, boron, titanium, zirconium, etc. Some nonferrous metal ores contain 20 or more valuable constituents. And yet the degree of recovery of metals from raw ore, in value terms, amounts to only 50-60 percent with existing technology, while as regards number of recovered elements from the total number in the ore, the level of utilization frequently amounts to 10-20 percent.

In addition to metals, ores as well as overburden and gangue contain valuable raw materials for the chemical and building materials industries. Many metals and other valuable constituents are lost in metallurgical processing waste -- slags, as well as dust and gases dissipated in the atmosphere. Large quantities of sulfur dioxide are discharged into the atmosphere, polluting the environment. Hundreds of millions of tons of slags and gangue, which contain many valuable constituents, have accumulated in the waste piles at ferrous and nonferrous metallurgical enterprises. They are essentially little inferior to ores. Of the greatest interest to the economy are zinc slags at zinc plants, which contain the greatest concentration of zinc, lead, iron, copper, calcium, and silica. The same applies to the large volumes of dry dusts produced in the process of production. They contain lead, zinc, cadmium, chlorine, arsenic, rare and scattered elements. Concentrated in the dusts generated by lead production as a whole are up to 70 percent of thallium, 55 percent of selenium, 40-50 percent of tellurium, 25 percent of indium, a large percentage of cadmium and other constituents of commercial value.

Waste generated in removing overburden, extracting and processing ferrous and nonferrous metal ores is little utilized. In 1980, for example, waste generated in mining and processing iron ore comprised only about 5 percent of crushed rock and construction sand production. And yet these products are quite inexpensive: 1.5-2 rubles per cubic meter of crushed rock, and 4 rubles per cubic meter of construction sand.

For the most part, the substantial volumes of secondary energy resources -- the heat contained in waste metallurgical process gases, gases of exothermic reactions during roasting and smelting of sulfide ores and concentrates, as well as the heat of slags -- generated in metallurgical production, are not utilized. In nonferrous metallurgy alone the annual volume of secondary energy resources suitable for recovery totals approximately 18 million gigacalories, while only about 4 million are practically utilized.

In connection with this, in our opinion a number of practical measures must be taken, in particular the mandatory performance of special calculations on comparative economic effectiveness of utilization of spent materials (slags) and new raw materials in determining the question of building enterprises for the production of non-ore construction materials in areas where waste rock and metallurgical slag are generated. Design organizations should also determine the question of building two or three enterprises (specialized shops) to produce nonferrous metals, based solely on processing waste materials from mining and metallurgical enterprise operations. One should take into consideration the fact that the technology of producing some important associated metals which are not presently being recovered from ferrous and nonferrous metal ores and slags is well known and fairly efficient, while a number of others are in the final development stages.

Certain positive results have been achieved in recent years in the area of comprehensive utilization of ferrous and nonferrous metal ores. In addition to iron, the ferrous metallurgical industry recovers vanadium, titanium, phosphorus, to some extent nickel and zirconium from iron ores, as well as the minerals siderite, quartzite, apatite, and baddeleyite. By-product production of the following has been set up: raw materials for the building materials industry (cement, crushed rock, gravel, construction sand, mineral wool): fertilizers -- from overburden and iron ore processing waste; silica filler -- from manganese ore processing waste. Alongside the 12 principal metals extracted from raw ore, the nonferrous metallurgical industry recovers an additional 62 elements, and also produces crushed rock and gravel, cement, pyrite and barite concentrates, soda and soda products, and sulfuric acid.

The above-listed measures, however, are insufficient for solving the problem of achieving fuller recovery and greater comprehensiveness of utilization of raw mineral resources. An important role in this area should be played by pricing. The influence of prices both in this industry and in the economy as a whole is based on the regulating role of the system of planned prices, which is manifested in the operation of their various functions: compensation, income, planning and record keeping, distribution, incentive, achieving uniformity, limiting, and informational.*

As regards current prices on ores and metal ore raw materials, they have become outdated to a significant degree and fail to reflect changes which have taken place in recent years in the structure and distribution of ore production and processing. Therefore in the course of revising wholesale prices and rates in industry, the system of prices on ferrous and nonferrous metal processed and unprocessed ores is being brought into conformity with the new economic conditions of their production and processing, and it will exert a greater influence on growth in efficiency both of the mining industry and of metallurgical production as a whole.

In many cases it is possible to increase the inc ive influence of prices on comprehensiveness of utilization of metallic ore only simultaneously with securement of substantial technological advance and improvement in planning and organization of the industrial utilization of these raw materials. In the future we believe that the economic limitedness of the natural resources of a number of metals, which heightens the necessity of promoting efficient consumption of raw ore, should be taken into consideration in improving the wholesale price system.

In this regard it seems feasible to adopt a fee payment when assessing the ores of certain extremely short-supply metals (platinum, tungsten, nickel, rhenium, niobium, tin, copper, cobalt, molybdenum, zinc, etc) as a way of taking into account

* The extensively employed classification and determination of the functions of a planned price reduce the content of the role and influence of prices on societal production basically to three functions -- planning-record keeping, distribution, and incentive. Some authors add the function of balancing supply and demand, plus an educational function. Without debating the question, we shall note that this impoverishes the actual content of the category of socialist (planned) price. On the other hand, there also exist views which unwarrantedly complicate the question by inventing a great many functions (as many as 20!).

the economic limitedness of a given mineral raw material natural resource, with subsequent reflection in wholesale prices on ore concentrates and intermediate products, as well as on the metals recovered from them.

Calculation of payment for limitedness of a resource is based on increase in economic effect obtained with utilization of a highly short-supply metal in the nation's economy according to a variant which gives it the greatest value in comparison with the most readily available substitute. The maximum value of increased effect should be adopted as the base because the fact of short supply of a number of metals and their alloys (platinum or tungsten, for example) is due primarily to their unique properties, their high use value, and the fact that they cannot be entirely replaced under the given conditions, or substitution is possible only on a limited basis. At the same time the ores of these metals are in extremely short supply as regards known resources and resources being exploited.

A higher appraisal of resources of a metal which is in extremely short supply and unique in use value should also be employed in these extreme economic conditions with the aid of establishment of a fee payment. The concrete value of the fee payment (P_p), included through profit in the wholesale prices on ore, processed ore and metal (products of the three principal stages of utilization of metallic ore resources -- mining, concentration, and smelting of metal), and the total fee payment amount (P_t), distributed among production by stages of utilization of metal-ore resources, are determined by the following formulas:

$$R_p = P_t K;$$

$$P_t = E_{max} - E_{min},$$

where E_{max}, E_{min} is the value of the maximum and minimum economic effect of utilization of the resource of a given metal; K -- coefficient of distribution of the total fee payment by categories of product of the processing of raw metallic ore.

The value of K is assumed equal to 0.33, since the problem of efficient utilization of metallic ore resources is equally acute at all principal stages of processing, and in our opinion possibilities of increasing completeness and comprehensiveness of ore utilization and eliminating losses are practically equivalent. Mines, mining and concentration combines, and metallurgical plants should pay to the state up to 50 percent of the fee payment formed after selling the corresponding product, with the remaining 50 percent going in equal shares for recontouring and replanting land disturbed by mining operations, environmental protection, and incentive payments (bonuses) to those workers directly responsible for increasing recovery of valuable constituents from the ore, for increasing the degree of comprehensiveness of ore utilization, reducing ore, ore concentrate, and metal losses, and improving their quality.

The mechanism of fee payments would make it possible to provide additional incentive for more efficient utilization of metallic ore resources, to achieve metal savings in the economy, and to create a source of financing environmental protection measures both on a nationwide scale and on a scale of the individual plant. This will promote increased recovery of metals during concentration and in metallurgical processing -- the weakest point in the system of price incentives to encourage efficient utilization of raw mineral resources at the present time.

With the existing pricing mechanism, system of figuring and evaluating the performance of mining enterprises, it frequently occurs that enterprises do not seek to achieve savings in mineral raw materials or comprehensive ore processing. This situation is due in particular to the fact that many attendant constituents in the initial raw material (concentrates) do not have prices, are not considered in specifications, and therefore do not affect determination of the economic value of ore deposits. Therefore improvement of wholesale prices on ores and concentrates of ferrous and nonferrous metals should reflect a broadening of the range of commercially useful constituents paid for in complex ores; strengthening of the incentive role of prices in improving the quality of ore and its intermediate products on the basis of fuller consideration of their metallurgical value and expansion of the number of wholesale price additional payments for achieving higher quality parameters and maximum recovery of valuable constituents from a complex ore; elaboration and adoption of limit (cadastre) prices on ore deposits.

Establishment of a price or price supplement for a new, prior unrecovered constituent should be based on the availability of a corresponding satisfactory commercial process, need for that constituent by the economy (or for export), and allowable variations in extraction costs (if an analogue exists) which still ensure benefit to the economy. It is advisable more extensively to employ the adoption both of independent prices and of supplementary price amounts for recovery of a new associated constituent, as well as for increased content of that constituent in the ore concentrate. For example, it makes sense to study the question of adding additional amounts to wholesale prices on copper, zinc and lead concentrate for by-product recovery of a number of rare and noble nonferrous metals during production of sulfide ore concentrates.

Current prices on ore and its intermediate products inadequately consider their main use property -- metallurgical value. For example, calculations on the correspondence of wholesale prices for Krivbass iron ore and the cost equivalent of its metallurgical value revealed substantial deviations -- for the most part ranging from 7 to 45 percent for various categories of ore. It is advisable in all cases to ensure a sufficiently full consideration of the metallurgical value of the various categories of ore raw material -- the principal indicator of their use value, which is determined by the content not only of the principal constituent, but of other constituents also and their character (harmfulness, basicity, specific heat), as well as the degree of economy of metallurgical processing of the raw material. In particular, valuation of the metal in a concentrate (by types and grades) should be differentiated according to metallurgical value and approximate equality of calculated outlays per ton of raw metal in smelting concentrates of various quality.

Prices and price premiums provide material incentive to increase the yield of metals in those concentrates and intermediate products from which they are most fully and economically recovered in metallurgical processing. In connection with this there should be an improvement in differentiation of prices by types and grades of raw ore and intermediate products. It should be accomplished on the basis not only of division of valuation of metal in the ore by grades and by cost of mining and concentration, but also an objective reflection of its economic effectiveness taking into account metallurgical value.

It is also important to develop a system of price premiums (discounts) on wholesale prices for raw materials for decreased (increased) content of harmful impurities (sulfur and carbonates in bauxite, sulfur and ammonia in lead and zinc concentrates, sulfur and silica in iron ore, etc) which significantly lessen the metallurgical value of the raw material.

Fuller consideration of the metallurgical value of iron ore, for example, would be fostered by elaboration and establishment of price premiums (discounts) on wholesale prices for iron ores and concentrates for averaging of iron and silica content in their delivered physical bulk. It is also necessary to develop orderly methods of calculating the cost of products obtained only from complex raw material and methods of evaluating attendant intermediate products. In particular, it is necessary to elaborate a common (independent of ministerial subordination) method approach to product costing.

The following can serve as additional economic measures in the area of price incentive for encouraging efficient utilization of raw ore:

including in production cost and price contributions to a centralized bonus fund for above-norm ore extraction from worked-out sections of ore bodies. These funds could be used to compensate for additional expenditures on selective production from exhausted levels and for paying the cost of transport and other services with decreasing production volumes;

introducing a payment (fine) at mining enterprises for lost reserves and failure to maintain the requisite level of recovery of reserves of commercial minerals during mining operations. This amount should be taken from the profit on the production in connection with which such losses occurred. The magnitude of such a payment reflects that portion of the economic consequences of inefficient utilization of metallic ore which at the present time is not considered in enterprise economic accounting and is paid for by the state budget. We are specifically referring to the calculated amount of expenditures on geological prospecting and exploration applied to the lost quantity of ore reserves. The appropriate sum should be distributed among the produced analogous product, figured on a per-ton basis.

Implementation of the above discussed measures and recommendations, alongside employment of other methods of economic incentive, will in our opinion help strengthen the influence of the economic mechanism on increasing efficiency of utilization of valuable and nonrenewable ore resources, metals and all societal production.

3024
CSO: 1842/24

NORIL'SK METALLURGICAL COMBINE COMPLETION DELAYS

Moscow SOTSIALISTICHESKAYA INDUSTRIYA in Russian 16 Oct 81 p 3

[Article by SOTSIALISTICHESKAYA INDUSTRIYA special correspondent S. Sadoshenko, Noril'sk-Krasnoyarsk: "Time of Tests"]

> [Text] In January SOTSIALISTICHESKAYA INDUSTRIYA published the pledges of the Noril'sk Mining and Metallurgical Combine for 1981. They contain the following item: "Increase nonferrous metals output by several percent in 1981 over 1980 by bringing new facilities on-stream, on the basis of further technological improvement and retooling of existing production facilities, extensive adoption of new equipment, advanced technology and labor methods...."

July was hot this year in Noril'sk. Although patches of snow lay here and there on the hillslopes, as is the case every year, in the afternoons the sun beat down mercilessly, just like in the South. Things were particularly difficult for the workers at the mining and metallurgical combine, for here, beyond the Arctic Circle, everything is designed to preserve heat, not to get rid of it. The official document of acceptance of the second unit of the Nadezhda Metallurgical Plant (NMZ) was signed right in the middle of this hot month of July. That same month the enterprise was targeted to increase its physical output by almost one half. Therefore it was hot not only in the direct meaning of the word but also in a figurative sense.

I recall that four months after publication of the pledges, at a meeting of the CPSU kray committee bureau, at which they were discussing the question of bringing production facilities on-stream, one of the bureau members asked combine director B. Kolesnikov: "How much metal are you planning to produce in the current five-year plan due to bringing new facilities on-stream?"

"Almost the entire incremental growth," he replied.

We see that the pledges, the targets for this year and for the entire five-year plan and, if we consider that the Noril'sk Combine is the largest of the branch, the directive figures for this country's copper and nickel production are all closely linked with movement on-stream of new facilities at the combine. Nadezhda was first on the list of facilities to come on-line. The first unit of the NMZ was to reach designed output by 10 October 1981. Equipment of the second unit was to reach designed output level even sooner, in July (this was why the plan increased so sharply).

The following question, brought up at that same bureau meeting, was most appropriate: will there be sufficient ability and manpower to bring facilities on-stream substantially ahead of schedule? For the construction workers of Taymyrenergostroy were five months behind schedule in turning over second-unit equipment for comprehensive testing.

No miracle occurred. The Nadezhda workers did not even complete by half the July target, calling for the plant's second unit to reach designed production loading. And how about things at the first unit? Unfortunately completion has reached only slightly more than 50 percent there.

To be quite fair about it, we must state that the Siberians encountered many difficulties on the road to the end objective. The first unit of the NMZ is a unique technology which has not been employed anywhere else, while the second unit is a technology developed in a number of foreign countries, but it is being installed at Noril'sk for the first time in this country. Certainly the construction people also have justification, for it is no easy job to construct these shops, to install this equipment, and to erect these gas-scrubber stacks on permafrost ground, in gale winds and bitter cold weather.

But I should like to draw attention to another aspect of the question, for when they made their pledges, both plant and construction workers nevertheless gave their word to build faster and complete sooner. Could it be that they had no idea of the difficulties which they would encounter? Let us see.

Engineer A. Voronov was involved in the initial development of the process installed in the first unit of Nadezhda. Candidate of Technical Sciences Al'bert Borisovich is now in charge of the Nadezhda Metallurgical Plant. He, as they say, is holding the cards

"We see three weak points in the plant's first unit," stated A. Voronov, "which prevent us from reaching designed output."

Autoclaves are the heart of hydrometallurgical processing, for it is here that leaching of the pyrrhotine concentrate takes place. The Moscow Scientific Research Institute of Chemical Machine Building designed them of double-layer steel. "They won't hold up," the plant people warned the designers. The latter replied: "There is not a single plant in the country which would agree to build the 15-meter autoclaves as you demand, of double-layer steel and lined with lead and acid-resisting brick." So they made duplex-metal autoclaves, without lining.

The autoclaves began to corrode after 3300 hours of operation. At this point they began sounding the alarm. The people at the plant said to the designers: "We told you so." The latter replied: "What else could we do at the time? Now there is a plant in Penza which can build the autoclaves you want. Go ahead and place an order."

Thus the work force was well aware of the entire complexity of the matter of the autoclaves when they proceeded to draft socialist pledges for this year. They were also aware that the only pyrrhotine concentrate thickener works at half the productivity as predicted by the Mekhanobr Design Institute. And they are aware of the fact that, due to a design error, the output of the pumping station which

pumps out tailings does not exceed 30 percent of designed output. What were the metallurgical workers thinking about when they pledged to achieve such a substantial increase in metal production?

There are even more difficulties with the second unit. When they were drafting pledges it was already obvious that they would be commencing comprehensive testing of the facility behind schedule. Due to construction delays, they lost the warranty obligations of the manufacturers to bring the equipment up to designed output. In other words, they would have to bring the equipment up to designed output by themselves, without the assistance of foreign installation supervisors.

There still would have been some hope if all the equipment brought on-line worked properly, but it refused to do so. Take anode furnace No 3, which produced the first blister copper anodes. V. Bakhtin's smelter brigade operates this furnace. Half of the work force are young people, novices. The brigade leader recalls a recent incident. The gauges indicated normal oxygen content in the melt, and there seemed to be no reason for concern. But Vladimir Akimovich had this feeling that something was wrong, so he took a copper analysis. It turned out that the gauges were "lying." It was only the brigade leader's experience which saved the melt.

A great many such examples could be cited. There is nothing surprising about this: the equipment has not yet been "broken in," and the workers do not yet have a handle on the entire metal production process; the Nadezhda work force is still in the process of formation.

"What problems would have arisen, Al'bert Borisovich, if Nadezhda had been brought up to designed output on schedule?" I deliberately asked the director of NMZ, for I had visited the copper plant previously.

"Problems of raw materials and marketing the anode copper," Voronov replied without hesitation. And he was entirely correct.

Production at the Talnakh Concentration Mill is slow in coming up to designed output, and the quality of the produced concentrate is appreciably below the desired level at present. The problem of the combine's ore supply is a separate matter, but I should like to make just one comment: if Nadezhda had come up to full production in July, the concentration mill people would have had a difficult time of it.

Marketing the product is another matter. Plans call for further processing the anode copper at the combine's copper plant. To be quite honest, the people at this plant are secretly pleased at the fact that the metallurgical plant has been plagued by delays, for otherwise the electrolysis people at the copper plant would be in quite a predicament, since these facilities have not yet come on-line.

The city party organization and Nadezhda party committee are undertaking effective steps to speed up movement of plant facilities on-stream. The combine was recently visited by the USSR Minister of Nonferrous Metallurgy, and representatives of the All-Union Association are constantly visiting. There is no doubt whatsoever that through combined efforts Nadezhda will be brought up to designed output either this year or next. The question, I repeat, lies elsewhere: why make doubtful pledges?

I believe the answer is that while they will be scolded and firmly penalized for failing to achieve plan targets, this will not happen for failure to meet pledges. Of course what could be better than to put facilities into production and bring up to designed output ahead of schedule? But if there is no such possibility, could they not face facts squarely and make other, realistic pledges? After all, nonfulfillment of a pledge makes one's word of less value. The Nadezhda work force is young, and these young workers should not begin their careers in this manner.

3024
CSO: 1842/21

UDC 621.762

INFLUENCE OF TITANIUM PARTICLE SIZE ON GROWTH OF PRESSINGS DURING LIQUID-PHASE SINTERING WITH ALUMINUM

Kiev POROSHKOVAYA METALLURGIYA in Russian No 9, Sep 81 (manuscript received after revision 1 Nov 80) pp 33-37

SAVITSKIY, A. P. and BURTSEV, N. N., Siberian Institute of Physics and Technology

[Abstract] A study is made of the influence of the dimensions of the particles of titanium powder on the growth of pressings containing a fixed concentration of aluminum during sintering in the temperature area above the melting point of the alloying additive. The pressings were prepared of PTEM-1 titanium powder and ASD-1 aluminum at 30 at .%. Metallographic analysis of model titanium particles sintered in the presence of liquid aluminum at 700°C indicated that an intermetallic layer forms on their surface which cracks and makes the particles porous. The growth of the pressings is found to vary directly with particle diameter. The anomalously high increase in pressing volumes results from development of the intermetallide. The maintenance of continuity of the material and small particles apparently results from the fact that the intermetallide which forms on the surface is too thin and cannot cause sufficient stress to crack the particles. Figures 4; references 2 Russian.
[8-6508]

UDC 621.762

STATUS OF OXYGEN IN HIGHLY DISPERSED TITANIUM NITRIDE POWDERS

Kiev POROSHKOVAYA METALLURGIYA in Russian No 9, Sep 81 (manuscript received 3 Jan 81) pp 6-9

TORBOV, V. I., TROITSKIY, V. N., ZUYEV, A. P., KIREYKO, V. V., DOMASHNEV, I. A., BERESTENKO, V. I. and TORBOVA, O. D., Institute of New Chemical Problems, USSR Academy of Sciences

[Abstract] A study is made of the influece of the conditions of production, duration of contact with moist air and vacuum-heat treatment of highly dispersed titanium nitride powders on the content of oxygen and the form of the oxygen

which is present. Titanium nitride was obtained by hydrogen reduction of $TiCl_4$ in a current of a nitrogen plasma generated by an SHF discharge. To eliminate the absorption of atmospheric moisture and oxygen, all of the powders studied were gathered from a filter in a sealed container, from which the air had been evacuated to about 1 Pa, filled with high purity nitrogen. All subsequent operations with the powders were performed in nitrogen. Titanium nitride powders were obtained with a variation in the flow rate of titanium chloride from 30 to 160 g/hr, of nitrogen from 1.6 to 4.1 and hydrogen from 0.5 to 0.6 m^3/hr. This resulted in a variation in the C_O/C_{Ti} ratio and the production of powders of varying dispersion (20-60 m^2/g). The content of oxygen in the powders produced was 1-5 mass%. The oxygen either displaced in the nitrogen in the nitride, formed oxide films or was adsorbed onto the surface of the metal. Contact with moist air causes a thin oxide film to be formed over the surface of the small particles, with activation conductivity and a portion of the oxygen in the adsorbed state. Figures 3; references 6: 5 Russian, 1 Western.
[8-6508]

UDC 621.762.274

INFLUENCE OF ELECTROLYSIS CONDITIONS ON FORMATION, STRUCTURE AND MAGNETIC PROPERTIES OF HIGHLY DISPERSED Fe-Co ALLOYS: REPORT II. INFLUENCE OF RATIO OF IRON TO COBALT IONS IN ELECTROLYTE

Kiev POROSHKOVAYA METALLURGIYA in Russian No 9, Sep 81 (manuscript received 31 Feb 81) pp 1-5

MYALKOVSKIY, V. V. and ZHELIBO, Ye. P., Colloid Chemistry and Water Chemistry Institute, Ukrainian Academy of Sciences

[Abstract] A study is made of the influence of the ratio of iron to cobalt ions in the solution on the rate of precipitation of the alloy, yield per unit of current and structure and magnetic properties of highly dispersed Fe-Co alloys. The higher the concentration of one of the components in the electrolyte, the greater its concentration in the alloy and the greater its yield per unit of current. The crystalline structure of the alloys may change with varying relationships of the components, converting from one phase to another. As the content of Co ions in the electrolyte increases, the submicroscopic structure of α-phase iron-cobalt alloy particles is destroyed. The coersive force and magnetic induction of highly dispersed iron-cobalt alloys is always higher in powders produced from dilute electrolytes, no matter what the ratio of the components. Figures 5; references 3: 2 Russian, 1 Western.
[8-6508]

ECONOMICAL ROLLED STEEL PRODUCTS URGED

Moscow SOVETSKAYA ROSSIYA in Russian 11 Oct 81 pp 1-2

[Article by engineer L. Malinovskiy: "Debate in a Hot Shop"]

[Text] An article entitled "Shortage With a Surplus," which appeared in the 21 May issue of this newspaper, is based on a typical situation. The construction schedule for an oxygen-converter shop is not being met at the Orsk-Khalilovo Combine. What is the reason? USSR Minmontazhspetsstroy [Ministry of Installation and Special Construction Work] plants are delaying the delivery of essential structural members. Why is this? Enterprises of USSR Minchermet [Ministry of Ferrous Metallurgy] failed to supply the erectors with the requisite rolled stock. All these problems are rooted in the fact that the established system of indices, and therefore material incentive, focuses metallurgical workers on quantitative production growth. Product qualities of interest to the customer do not play an adequate role for the manufacturer.

In response to the editors, V. Vanchikov, deputy chairman of USSR Gosplan, reports that in the 11th Five-Year Plan there will be an increase in the manufacture of economical rolled products, that ministries and agencies have been instructed to reduce metal consumption, that many substitutes will be manufactured, that an "effective ton" indicator will be introduced for planning purposes, etc. Here is what is disturbing, however: it remains unclear what measures of an economic nature USSR Gosplan is willing to adopt in a practical manner today, right now, in order to ensure that the consuming branches receive metallurgical products precisely as ordered and as scheduled. Nor is the matter clarified by the reply by D. Galkin, USSR first deputy minister of ferrous metallurgy, published on 29 August of this year. The impression is formed that the author is least concerned by present difficulties connected with nonfulfillment of the finished product deliveries plan. The letter goes into detail about the future, but what should be done right now?

Many different economical types of metal can be produced, but if the customer does not receive the required sectional shape and on schedule, there will be little benefit from such intrabranch achievements. This is precisely the way things stand in practice. For example, the metallurgical industry met the overall finished rolled stock production target for the first six months of this year by 99.7 percent. The target pertaining to specific order specifications, however, was met by only 80 percent. The result is that one fifth of "surplus" rolled stock is "forced upon" the customer.

Let us picture the following situation. A customer orders sheet 4 millimeters thick. The metallurgical workers, however, offer 6-millimeter sheet. The fear of ending up without anything forces the customer to agree to the substitution. The size difference seems small, but here is what happens: parts made of the thicker sheet end up 50 percent heavier. In the second place, the enterprise will have enough sheet only for two thirds of the targeted production. This is a most widespread situation. Regular failure by USSR Minchermet to meet supply targets is one of the principal reasons for the high metal input figure for machine building products. In addition, making machining blanks heavier leads to increased volume of chips. Up to 9 million tons of chips are swept up each year.

In response to criticism, Minchermet officials state that they are taking steps to strengthen discipline in supplying orders and are expanding production of economical rolled stock. Thanks to this, in the 10th Five-Year Plan USSR Minchermet saved the economy 3 million tons of metal. But they fail to mention that machine building enterprises and construction jobs overexpended 7 million tons due to failure to deliver the targeted variety of rolled metal products. As we see, the overall balance sheet does not favor the metallurgical workers.

Conclusion: one of the principal ways to overcome the metal products shortage is to turn out rolled products strictly in conformity with the ordered product mix. That is, it is necessary more fully to satisfy the requirements of the nation's economy. This is of course a difficult but realistic task. I shall cite an example.

In the 1950's I was working at the Makeyevka Metallurgical Plant. That enterprise was constantly failing to meet production targets, not only as regards product mix but gross output as well. Nevertheless, wage bonuses were paid. For what? For the fact that the so-called output quotas (taking difficulty factors into account) were being met and even surpassed by the work forces. V. Kulikov, who was the plant's chief engineer at that time (presently first deputy chairman of USSR Gossnab), stated: "If a furnace run is not according to specifications, if a rolling mill fails to produce rolled product according to order specifications, and if the target pertaining to filling orders is not met because of this, a poor job has been done, and wage bonuses should not be paid."

He did not limit himself merely to words. He adopted a procedure whereby product which failed to meet order specifications was no longer counted for figuring wage bonuses. At first this new procedure was fought bitterly. But as people realized its fairness, passions abated. The plant began to do a better job of meeting supply order specifications on rolled products. Unfortunately the system adopted at the Makeyevka Plant was not adopted elsewhere, and that is unfortunate, because failure to fulfill the supply delivery plan is costly not only to metallurgical product customers but to the producers as well.

If a furnace run, for example, fails to meet order specifications and customers cannot be found who are willing to accept rolled product made of the specific grade of steel, it will end up in dead storage, resulting in a waste of the labor of hundreds of specialists and workers. In addition, blooming mill work rhythm is disrupted and its productivity declines; the number of cold ingots loaded into its soaking pits increases, and so does fuel consumption.

Let us proceed further along the production chain. If the blooming mill fails to turn out the required product on schedule, subsequent rolling mill idle time becomes inevitable. As we know, very tightly-scheduled plan targets are assigned to rolling mills, and if they stand idle, it is practically impossible to make up for the production loss. All this once again proves the importance and necessity of strictly meeting customer order specifications. But administrative measures alone are insufficient to achieve success in this area. The total technical policy of USSR Minchermet should be focused on satisfying customer needs. At the present time, however, this industry's technology is subordinated exclusively to ministerial, "tonnage" interests. That which is not in conformity with these interests is adopted either extremely slowly or not at all. There are many examples of this.

The Krasnaya Zvezda and Belinsksel'mash agricultural machine building plants asked the metallurgical industry two years ago to replace arc-welded pipe of one grade of steel with pipe of another grade, thinner-walled and easily weldable, which would make it possible to increase the reliability and reduce the metal input of the seeders manufactured at these plants. This idea, which in general is a good one, has not yet been implemented, but is drowning in endless correspondence and discussion with the plants and the technical administration of USSR Minchermet.

Here is another fact. In 1978 the Kryukovo Railcar Plant submitted a request to USSR Minchermet to provide it annually with 3000 tons of hot-rolled channel-section steel. Potential metal savings at the Kryukovo Plant, utilizing the new channel section steel, could amount to 23 percent of total annual consumption volume. The metallurgy people replied that it was inexpedient to rearrange production for the sake of 3000 tons. Plant specialists then placed an order for 4500 tons for the following year. Unfortunately, however, they were again turned down. This time officials at USSR Minchermet cited another reason for the refusal, that the requested sectional shape was too complex to manufacture.

The metallurgical people sometimes go to extremes in their disinclination to produce new structural shapes. There occur instances where the order is large, the structural shape is simple, and savings are obvious. Wishing to discourage the customer from efficient rolled products, however, USSR Minchermet sets such a high price on the ordered structural shapes that the customer is forced to forget about it.

In my opinion new prices should be determined on the basis of the cost of producing an item.

USSR Minchermet displays even greater obduracy when new manufacturing processes are suggested by outside organizations. The Electric Welding Institute imeni Paton and the All-Union Scientific Research Institute of Metallurgical Machine Building once proposed a unique method of obtaining economical rolled sectional shapes: two short T-sections are radio-frequency welded together. The process was thoroughly worked out on a test unit. Complete plans were drawn up for a commercial model. In 1976 USSR Gosplan made the decision to build this mill at the Kommunarsk Plant. Targeted output capacity was 350,000 tons of rolled sectional steel annually. Metal savings from weight reduction were targeted at 120,000 tons, and money savings -- 10 million rubles. For five years now, however, USSR Minchermet has been postponing construction of the new mill under various pretexts.

Two years ago the All-Union Scientific Research Institute of Metallurgical Machine Building developed a process for manufacturing thin-walled pipe with a wall thickness of 3 instead of 6 millimeters. But USSR Minchermet has also refused to bring this process on-line. No intelligible reasons for this refusal have been brought forth. This probably would have been the end of this matter if specialists at the USSR Ministry of Construction of Petroleum and Gas Industry Enterprises had not taken an interest in this efficient process. They tried it out at one of their plants (in the city of Almet'yevsk). Four mills are presently operating there. Each can produce 100,000 tons of pipe per year. Metal savings from reducing wall thickness totals 400,000 tons per year. Two more units are now being installed at an accelerated pace.

USSR Minchermet officials also show totally unwarranted conservatism in handling problems pertaining to construction of small-output metallurgical plants. The Principal Directions specify construction of small plants in some parts of the country to supply small enterprises with rolled products. The idea is that they would operate on local scrap metal, which in the final analysis will reduce transport costs for supplying scrap. The Ministry of Ferrous Metallurgy and the Ministry of Heavy and Transport Machine Building submitted proposals. Each specifies manufacture of wire rods, light and medium rolled stock. Annual volume would be 500,000 tons. Capital outlays for plant construction as well as production cost (according to calculations performed at the two ministries) are very close, with only minor differences.

The version prepared by the metallurgical people specifies a manufacturing process whereby the rolled product would be made of common grades of steel. The machine building people propose automating the entire manufacturing process and producing billets of structural, low-alloy and high-grade alloy seals. The proposed versions were examined at the joint scientific and technical council of the two ministries, with the participation of leading experts. In spite of the arguments presented by E. Zvizhulev and Ye. Matveyev, deputy ministers of heavy and transport machine building, the metallurgical people -- represented by deputy ministers A. Borisov and S. Kolpakov, remained steadfast and have continued to defend their position. This debate, which has dragged on too long, should be brought to an end by the interested organizations -- USSR Gosplan, USSR Gosstroy, and the USSR State Committee for Science and Technology. The opinion of the customer, who is strongly in favor of the version proposed by the machine builders, should be the deciding factor, and here is why. Consumption of high-grade rolled stock (in place of common grade) will help reduce metal consumption by 16-20 percent.

This case is not the only example attesting to the disinclination of USSR Minchermet to cross the threshold of narrow departmentalism for the sake of the customer. At one time in the past the question of what pipe is more economical -- welded or seamless-rolled, was being determined. The metallurgical people argued in favor of seamless-rolled. They even urged this method for producing large-diameter (720-820 mm) pipe for natural gas pipelines. It required a great effort to obtain acceptance of the opposing proposal. Today preference is given to welded pipe not only in this country but throughout the world.

Adoption by the metallurgical industry of new, tougher standards (GOST) on products could also greatly promote the manufacture of economical rolled products. Probably

everybody knows that any item manufactured according to a given set of plans has quite specific dimensions. It is impossible, however, to attain absolutely precise figures. Therefore working drawings specify a nominal dimension and allowable departure from it. Usually both downward (negative tolerance zone) and upward (positive tolerance zone) tolerances are specified. Current GOST permit considerably greater dimensional tolerances than are actually achieved on mills currently in operation.

By increasing the accuracy of the geometrical dimensions of rolled product, it is possible to save on the average one and a half percent on merchant shapes, three percent on hot-rolled sheet, and five percent on cold-rolled sheet. But this requires adoption of a new GOST, which would specify manufacture of metal products with a narrower tolerance zone. This organizational measure will help save approximately 1 million tons of finished rolled product annually.

In conclusion I should like to submit for discussion a proposal which applies to the metallurgical industry as a whole. In my opinion, USSR Gosplan must refrain from planning rolled stock production according to the principle of "from the achieved level" and shift to a scientifically substantiated method of ratifying targets. Calculations should be based on the labor intensiveness of manufacture of structural shapes on each specific mill. The rolled product output growth rate may slow down somewhat, but the order specifications of the customer branches will be one hundred percent met. For in the final analysis not only quantity but also quality is important.

3024
CSO: 1842/15

INFLUENCE OF ELECTROTHERMAL HARDENING CONDITIONS ON MECHANICAL PROPERTIES OF ShKh15 STEEL

Moscow METALLOVEDENIYE I TERMICHESKAYA OBRABOTKA METALLOV in Russian No 9, Sep 81 pp 10-12

SHEPELYAKOVSKIY, K. Z., KUZNETSOV, A. N. and GUBENKO, V. T.

[Abstract] A study is presented of the influence of the temperature and time parameters of induction heating for hardening on the mechanical properties of rings for ShKh15 steel rolling friction bearings. The mechanical properties were determined after electrothermal hardening involving induction heating to 820-950°C, isothermal holding for 5-300 sec, cooling in a stream of water and electrotempering of the rings at 230°C, 60 Sec. A comparison was made with rings heat treated by the usual technology involving furnace heating. It is found that as the heating temperature and isothermal holding time are increased, the true flow stress increases. Increasing the temperature from 820 to 950°C results in an increase in flow stress from 3650 to 4200 MPa, while increasing the time from 20 to 300 Sec at 850°C results in an increase from 3750 to 4200 MPa. It is concluded that induction heating facilitates formation of smaller grains and thus achievement of higher strength, increasing service life and reliability. Figures 3; references 3 Russian.
[9-6508]

INFLUENCE OF NITRIDING IN ELECTROLYTE PLASMA ON FRICTION CHARACTERISTICS OF 40Kh STEEL

Kishinev ELEKTRONNAYA OBRABOTKA MATERIALOV in Russian No 4, Jul-Aug 81 (manuscript received 29 Dec 80) pp 43-45

BELKIN, P. N., PASINKOVSKIY, Ye. A., TKACHENKO, Yu. G., FAKTOROVICH, A. A., and YULYUGIN, V. K., Kishinev, Kiev

[Abstract] One simple technology for nitriding is to immerse the part being treated, connected as an anode, into a solution in which it is heated to the saturation point, held for several minutes, then cooled in the same electrolyte. Nitriding of medium-carbon steels has shown that the main phase formed is martensite nitride if hardening is performed after the treatment. This work studies the wear resistance of 40Kh steel in dry friction after nitriding in an electrolyte plasma by this method. The data obtained confirm that the optimal relationship of usage properties for medium carbon steel nitrided in an electrolyte plasma is achieved at a saturation temperature of 700-750°C in an electrolyte consisting of 1 to 10% ammonium chloride plus 5% ammonia or 11% ammonium chloride plus 11% ammonia. The duration of nitriding is determining by the specific requirements for the depth of the diffusion layer on the part. Figures 3; references 5 Russian.
[14-6508]

INFLUENCE OF ELECTRON BOMBARDMENT ON Kh18N9T STEEL

Kishinev ELEKTRONNAYA OBRABOTKA MATERIALOV in Russian No 4, Jul-Aug 81
(manuscript received 15 Sep 80) pp 39-40

MARKOVSKIY, Ye. A. and KRASNOSHCHEKOV, M. M., Kiev

[Abstract] Materials are presented on the electron bombardment of Kh18N9T steel. Cylindrical steel specimens 8 mm in diameter were bombarded by a flux of 5 MeV electrons while being cooled with running water. The temperature of the bombarded end reached 900°C. After bombardment the Vickers hardness was measured, and x-ray structural analysis and x-ray spectral microanalysis were performed on the 21 specimens. The hardness was found to increase by a maximum of 29%, an average of 16%. Microspectral analysis showed that chromium was distributed nonuniformly, being about 9% in the middle, twice as much at each end. The liquation of the chromium corresponded with the nature of the change in microhardness. There was an increase in distortions of the crystalline lattice and a decrease in block size in the bombarded specimens.
[14-6508]

UDC 546.273.171

SOME PROPERTIES OF CUBIC BORON NITRIDE CRYSTALS DOPED WITH SILICON

Kiev SVERKHTVERDYYE MATERIALY in Russian No 4, Jul-Aug 81 (manuscript received 19 May 80) pp 20-23

SHIPILO, V. B., GUSEVA, I. P., SHISHONOK, N. A., GAMEZA, L. M., AKHMETOVA, Ye. I. and KUDEL'SKAYA, N. D., Minsk, Institute of Solid State Physics and Semiconductors, Belorussian Academy of Sciences

[Abstract] A study was made of the microcrystallomorphologic specifics, dislocation density, microhardness and density of CBN crystals produced at 4.0-4.3 GPa, T=1860-2320 K, time τ=1-45 min. Pressure calibration was performed at room temperature. The studies showed that in the upper portion, not adjacent to the magnesium diboride, the CBN crystals usually had the form of three-sided or four-sided pyramids. In the lower portion adjacent to the magnesium diboride the CBN crystals did not show this structure. Etching pits on face (111) of CBN crystals, with and without 0.5 or 3.0 mass % silicon, were triangular pyramids. Heterogeneous distribution of silicon atoms in the volume of the specimens resulted in large accumulations of dislocations in individual areas. The density of undoped crystals is higher than the density of a standard polycrystalline specimen by 0.02-0.04 g/cm^3, and approximately equal to its mean value for high quality polycrystals (3.43-3.45 g/cm^3). Silicon doping significantly increases the density of the crystals. Dislocation density and microhardness are also increased, and the lattice constant is decreased. Figures 2; references 7: 6 Russian, 1 Western. [7-6508]

UDC 622.24.051.7:666.233:620.131.4

INFLUENCE OF HEATING CONDITIONS ON STRENGTH OF SYNTHETIC DIAMONDS

Kiev SVERKHTVERDYYE MATERIALY in Russian No 4, Jul-Aug 81 (manuscript received 12 Dec 80) pp 9-11

GARGIN, V. G., Kiev, Institute of Superhard Materials, Ukrainian Academy of Sciences

[Abstract] To study the ability of the gas medium in which diamond tools are manufactured to damage the surface of the diamond grains, three batches of synthetic diamonds containing 0.16, 0.70 and 2.60% impurities were heated in argon,

nitrogen, hydrogen, CO/CO_2 and air to 670-1670°K, holding time 20 minutes. The strength reduction of the diamonds was qualitatively similar and corresponded to values measured earlier.

Heating of the diamonds in media containing oxygen was found to cause partial oxidation of the grains and formation of microscopic defects on the surface. Surface damage was found even when diamonds were heated for only two seconds. Figures 3; references 8: 7 Russian, 1 Western.
[7-6508]

UDC 621.742.48

THERMODYNAMIC ANALYSIS OF INTERACTION OF DIAMOND, GRAPHITE AND CBN WITH OXIDES

Kiev SVERKHTVERDYYE MATERIALY in Russian No 5, Sep-Oct 81 (manuscript received 31 Mar 81) pp 14-19

SHILO, A. Ye., Kiev, Institute of Superhard Materials, Ukrainian Academy of Sciences

[Abstract] Information is presented allowing evaluation of the possibility of interactions in the systems oxide-diamond, oxide-cubic boron nitride and oxide-graphite based on the thermodynamic properties of the initial reaction components, in this case the thermodynamic properties of the oxides. Analysis of the reaction equations indicates that the excess isobaric-isothermic potential of the reactions depends only on the thermodynamic properties of the oxides participating in them. It is anticipated that the isobaric-isothermic potential of the reaction will be inversely proportional to the isobaric-isothermic potential of the oxide. The potentials for the formation of oxides from simple substances are presented in tabular form. The nomograms and equations will be quite useful in the development of tools of superhard materials, composites based on diamonds or CBN and oxides, as well as oxide coatings for superhard metal powders. They allow rapid estimation of the possibility of interaction of diamond, graphite and CBN with oxides and materials based on them and therefore a rational approach to the selection of these materials in the manufacture of composites and application of oxide coatings to very hard materials. References 12 Russian.
[30-6508]

UDC 539.89

HIGH PRESSURE AND HIGH TEMPERATURE APPARATUS WITH LARGE OPERATING VOLUME

Kiev SVERKHTVERDYYE MATERIALY in Russian No 5, Sep-Oct 81 (manuscript received 17 Mar 81) pp 3-7

SEMERCHAN, A. A., KUZIN, N. N. and DAVYDOVA, T. N., Moscow, Institute of High Pressure Physics, USSR Academy of Sciences

[Abstract] The authors' institute has been working for a number of years on the creation of apparatus allowing the achievement of pressures up to 80-100 kbar and higher in comparatively large volumes. Diagrams and descriptions are presented of apparatus with effective volumes of 85 and 200 cm^3 for use in a 50,000 ton hydraulic press. This apparatus has been used for synthesis of diamond powder at pressures of 60-70 kbar. This requires a force of up to 70 MN for the 85 cm^3 apparatus, 110-120 MN for the 200 cm^3 apparatus. A high pressure apparatus with a 160 mm diameter chamber, volume 840 cm^3, has been planned for studies at pressures of up to 80-100 kbar, requiring a force of 500 MN. Apparatus with 200 and 250 mm diameter chambers, volumes 1500 and 3000 cm^3, are also being developed for operation at up to 55-60 kbar. Figures 5; references 4: 3 Russian, 1 Western. [30-6508]

UDC 666.233-987

HEAT TREATMENT OF HARD ALLOY MATRICES FOR SYNTHESIS OF SV DIAMONDS

Kiev SVERKHTVERDYYE MATERIALY in Russian No 4, Jul-Aug 81 (manuscript received 4 Mar 81) pp 3-5

AVERCHENKOV, V. I., NADUVAYEV, V. V., Bryansk, and LOSHAK, M. G., Kiev, Bryansk Institute of Transport Machine Building; Institute of Superhard Materials, Ukrainian Academy of Sciences

[Abstract] A special study was performed to determine the expediency of hardening hard alloy elements of high pressure apparatus by heat treatment for the conditions under which SV diamonds are sintered, including significantly higher than normal pressures and temperatures. Thirty matrices each of two batches of hard alloy were selected for the experiments. Half the matrices of each batch were heat treated. The main forms of failure of the unhardened matrices in subsequent strength testing were erosion of pits and volumetric brittle fracture, brittle fracture along planes parallel to the base and radial channel cracks. Matrices which had been heat treated failed primarily due to erosion of pits. Brittle fracture was decreased by approximately 40% by heat treatment. The durability of high pressure apparatus with heat treated matrices was 28 to 32% higher than that of apparatus with non-heat treated matrices. Heat treatment of tungsten-cobalt alloy matrices is therefore desirable. References 2 Russian. [7-6508]

INFLUENCE OF SHAPE CHANGE OF GRAINS DURING HIGH TEMPERATURE THERMOMECHANICAL WORKING ON STRENGTH OF STEELS

Moscow METALLOVEDENIYE I TERMICHESKAYA OBRABOTKA METALLOV in Russian No 9, Sep 81 pp 12-14

BASHCHENKO, A. P., VOZNESENSKIY, V. V. and IZOTOV, V. I., Central Scientific Research Institute of Ferrous Metallurgy imeni I. P. Bardin

[Abstract] Studies were performed using specimens of 40Kh2N2VA steel (0.4% C, 1.5% Ni; 1.4% Cr, 0.76% W, 0.43% Mn, 0.31% Si, 0.019% P, 0.008% S) measuring 7 x 12 x 70 mm, rolled in a single pass with 15-75% deformation at 870°C. The study of the structure as a function of degree of deformation showed that at the select deformation temperature it is not only the shape and dimensions of austenite grains which change, but also the dimensions of the martensite crystals and their substructure. The dimensions of twinning plates and dislocation rack crystals after ordinary hardening and HTMW were determined to find the influence of the substructure of the deformed austenite on the martensite structure. Comparison of the mechanical properties and changes in substructure indicates that the formation of a cellular structure does not lead to a reduction in martensite crystal size and practically does not increase strength properties. Figures 4; references 8: 6 Russian, 2 Western.
[9-6508]

TITANIUM

PRODUCTION IMPROVEMENTS AT TITANIUM-MAGNESIUM COMBINE

Alma-Ata NARODNOYE KHOZYAYSTVO KAZAKHSTANA in Russian № 8, Aug 81 pp 10-13

[Article by M. Baybekov, director of the Ust'-Kamenogorsk Titanium and Magnesium Combine, delegate to the 26th CPSU Congress: "Components of Labor Productivity Growth"]

> [Text] In nonferrous metallurgy... increase production chiefly by boosting labor productivity. (From the Principal Directions of Economic and Social Development of the USSR For 1981-1985 and the Period up to 1990)

Entering the new decade, the CPSU advanced an ambitious, scientifically substantiated program of further prosperity of the Soviet society. This program finds concrete embodiment in the Principal Directions of Economic and Social Development of the USSR For 1981-1985 and the Period Up to 1990, ratified by the 26th CPSU Congress.

The principal meaning of the party's economic strategy is a steady rise in the material and cultural living standards of our people. But the highroad toward achieving this noble goal must pass through an all-out improvement in production efficiency and labor productivity growth. Aware of this fact, the work force of the Ust'-Kamenogorsk Titanium and Magnesium Combine is directing its efforts toward successful accomplishment of its assigned tasks.

Our enterprise is young, only 16 years old. Thinking back over what has been accomplished during these years, one visually senses the forward movement of the work force. Sixteen years is not a long time. But so much has been accomplished in this time! The combine became profitable in the 8th Five-Year Plan, quickly mastering the complex production process. Designed output figures were exceeded in the 9th Five-Year Plan, and labor productivity increased sharply.

The last five-year plan was particularly fruitful. Output volume doubled designed output figures due to production process renovation, and product quality improved significantly. The total production increase was achieved in the former production space, without enlarging the work force, by boosting labor productivity. This most important economic indicator increased by 22.7 percent during the five-year period, in comparison with a targeted 20.1 percent.

We have utilized every possibility for accelerating labor productivity growth -- improvement in the technical level of production and labor productivity, and strengthening the effectiveness of socialist competition. Just as a result of adopting new equipment, for example, and carrying out measures pertaining to scientific organization of labor, plus efficiency innovation and inventing activities, we eliminated a total of 952 jobs.

In addition, output volume increased by 20.6 percent in the 10th Five-Year Plan in comparison with the preceding one. Above-target profits totaled 3,084,000 rubles.

I shall briefly discuss major, highly effective technical solutions which are helping boost production efficiency.

In the last five-year plan we incorporated, stage by stage, the country's largest electrolytic cells without cathode box, which made it possible to reduce by several thousand tons chlorine losses during magnesium electrolysis. Discharge of chlorine into the atmosphere through the gas-scrubbing system was reduced 2.2-fold, electrolytic cell output on a carnallite feed arrangement increased by 13.9 percent, and with a chlormagnesium arrangement -- by 6.3 percent. Total savings from the adoption of electrolytic cells without cathode boxes and through improvement amounted to the substantial sum of 1,111,400 rubles.

Even greater savings -- 1,334,200 rubles -- were obtained by replacing furnaces, reduction and separating equipment with higher-output equipment and employing a process of preparing reducing agent in a mixer. But automation of certain segments of the chlorination and rectification process of titanium tetrachloride production generated insignificant savings at first glance -- 78,900 rubles -- but it made it possible to free personnel from performing unhealthy operations.

The process of producing magnesium powder was also improved and perfected, resulting in additional savings of 379,400 rubles. Improvement of chlorination and condensation processes, automation of loading of raw materials into the chlorinator and titanium tetrachloride cleaning generated an additional 415,000 rubles.

We attach particular importance to solving the problem of total utilization of raw materials. In 1979-1980, for example, a process of producing vanadium chloride compounds was put into practice for the first time. Total savings amounted to 258,000 rubles.

A total of 65 measures were carried out in the 10th Five-Year Plan on the basis of new equipment plans. This made it possible not only to increase output volume but also to mechanize and automate manual labor in many production sections and to improve working conditions for the metallurgical workers. Total savings exceeded 5,771,000 rubles.

The combine's innovators are making a weighty contribution toward boosting the technological level of production. Over a period of five years they submitted more than 7,000 suggestions and filed 150 invention applications. A total of 5,525 efficiency innovation proposals and 92 inventions were adopted. This resulted in savings of 4,794,500 rubles.

Unquestionably the technical inventiveness of our metallurgical workers is an important constituent in accelerating labor productivity growth. We shall continue in the future relying on the assistance of innovators and shall make every effort to support and develop their initiative.

We have done and are continuing to do a great deal to improve qualitative indices in all production stage processes. Today the combine puts out 19 different products which meet state and branch standards and specifications. Seven have been awarded the honored pentagon, while 12 are first quality category. Sponge titanium, pig magnesium, scandium oxide, and vanadium pentoxide are equal in parameters to the highest Soviet and foreign standards.

The percentage share of products meeting the top quality category is increasing year by year. In 1975, for example, it amounted to 66.4 percent of total output, 79.3 percent in 1979, and 81.03 percent in 1980. In the last five-year plan millions of rubles worth of above-target output has borne the state Seal of Quality. This is a result of adoption of the comprehensive product and labor quality control system which was developed at our enterprise and adopted by a state commission in December 1979.

We attach particular importance to scientific organization of labor. Three NOT [Scientific Organization of Labor] councils and 29 innovative brigades are working on elaboration of measures in this area. In the last five-year plan 170 measures have been implemented, with total savings of 502,000 rubles, and with elimination of 146 jobs.

Alongside scientific organization of labor, we devote unabating attention to utilization of advanced know-how amassed in this country.

In 1978 we shifted over to the combined method of improving organization of labor and material incentive, employing the method of the Shchekino Chemical Combine. The first thing was to obtain suggestions from enterprise employees aimed at expanding service zones, to refine and revise standards materials and, on the basis of these materials, to determine standard personnel requirements in each structural subdivision, and to apply a norm-plan system. Toward this end, we first established permanent combined shop commissions and a permanent central commission. Members of the former included shop superintendents, foremen, mechanical engineers, rate setters, economists and progressive workers, while members of the central commission included chiefs of functional divisions, chief specialists, and representatives of public organizations.

Commission members drew up additional measures to improve the production process and organization of labor, and dealing with mechanization and automation of heavy and laborious manual operations. In addition, they proposed an efficient system of material incentive and created conditions for boosting worker skills and teaching them second and related jobs.

Combine specialists drew up new technically substantiated time and service standards. They calculated on the basis of current branch and intersectorial materials the total number of basic and auxiliary workers, engineers, technicians and office workers for each structural subdivision, in conformity with the ratified production

program. As a result, the percentage share of time-rate workers whose labor is norm-set was increased to 89.6 percent.

Standard branch figures were adopted for the number of basic and auxiliary workers employed in titanium production, standard norms for repair and maintenance of means of automation, monitoring and electrical measuring devices, in-shop transfer equipment and laboratory activities. Savings exceeding 160,000 rubles were achieved by improving rate setting.

Nor did the shop and central commissions ignore such an important element as explanation to the workers of the substance of the Shchekino method. An important role here was played by a questionnaire survey, which became a genuine public review of labor productivity growth reserves. In February 1979, for example, the labor and wages division distributed more than 600 questionnaires among workers, engineers, technicians and office employees. They were given the opportunity to make comments and suggestions on improving organization of labor, mastering additional jobs, expanding zones of servicing, revision of standards, as well as mechanization of heavy manual operations.

Analysis of the questionnaire data indicated that 93 percent of employees are acquainted with labor conditions according to the Shchekino method. In addition, the questionnaires contained 96 suggestions on improving organization of labor and production, 58 of which were adopted without delay. What is most important, we saw that people had a lively interest in utilization of this advanced method applicable to our combine.

V. P. Baluyev, foreman of Unified Shop No 7, was an initiator in transitioning to the Shchekino method. His brigade of electricians and transformer maintenance personnel was the first to change over to the norm-plan system, which essentially boils down to ensuring high-quality performance of tasks with less labor expenditures and corresponding additional wages. This system required a certain increase in labor intensity, precise observance of standard operating procedures, and improvement of supply and technical support. As a result the brigade began regularly accomplishing its tasks with fewer workers and increased labor productivity by up to 30 percent. Brigade member earnings increased by 20-25 percent.

Presently all production-process workers in the combine's principal shops are working on the norm-plan system, as well as magnesium production repair and maintenance service personnel and personnel of a number of auxiliary subdivisions. When all work forces change over to this system, adoption of the Shchekino method will be completed.

Application of more progressive time norms and expansion of servicing zones have made it possible to utilize part of the payroll fund savings for increasing metallurgical worker material incentive. In the period 1978-1980 one out of every six employees received a wage bonus increase of from 5 to 15 percent. On the average the minimum bonus to all workers was boosted to 25 percent, which has particularly affected auxiliary personnel, who either had not been receiving any bonus or a bonus not in excess of 10 percent of the basic wage.

A precise system has been established at the combine for providing material incentive to learn a second job and for expanding servicing zones. Presently approximately 250 workers receive each month wage additions in the amount of 10-30 percent of the basic wage. We also pay additional wages for performing the duties of workers temporarily absent due to illness, vacation, or travel on official business. On the whole, average earnings including additional wages for seniority and other items have increased by 14.1 percent during the five-year plan.

An aggregate of work economic incentive measures according to the Shchekino method and adoption of scientific and technological advances enabled the combine work force in the period 1977-1980 to bring on-stream new production facilities employing 98 persons. The actual size of the work force, however, remained at the 1979 level. Facilities brought on-stream this year will also be operated without increasing the work force.

In the final year of the 10th Five-Year Plan considerable work was done at the combine to improve collective forms of organization of labor and wages. Regulations on the brigade, its council and brigade leader were drawn up. They have been communicated to all primary work forces.

An important reserve potential for labor productivity growth lies in establishing a stable work force. We are doing everything possible to hold personnel, especially highly skilled workers: we are building housing and children's preschool facilities. Results are as follows: in 1976 the rate of turnover for industrial personnel was 13.5 percent, 11.2 percent in 1978, and 8.2 percent in 1980. Labor discipline has improved appreciably. Last year, for example, we lost only 46 man-days to absenteeism, while in 1976 these losses totaled 165 man-days.

Socialist competition has become a sure means of mobilizing production reserves. Each of our workers has personal pledges and a labor competition rival. We have set in motion at the combine a movement under the slogan: "Work without laggers." As they say, results are in evidence: at the enterprise every work team and every employee is accomplishing his plan targets.

All this promotes successful fulfillment of the state plan and socialist pledges. We shall note that during the last five-year plan the work force was the winner in nationwide and republic socialist competition 16 times. Based on performance results for 1976, we were awarded the challenge Red Banner of the Central Committee of the Kazakhstan Communist Party, the KaSSR Council of Ministers, the KaSSR Trade Union Council, and the Kazakhstan Komsomol Central Committee, while for 1979 performance results we were awarded the challenge Red Banner of the CPSU Central Committee, USSR Council of Ministers, All-Union Central Trade Union Council and Komsomol Central Committee.

Our metallurgical workers truly earned the award of two honorary titles -- "Communist Labor Collective" and "Enterprise of High Production Standards."

I was fortunate enough to take part in the proceedings of the 26th CPSU Congress. At this great party forum much was spoken about the further development of an important branch of the nation's economy -- nonferrous metallurgy. The work force of our combine should make a weighty contribution to this cause.

A tough production program has been adopted for the 11th Five-Year Plan. In conformity with the control figures of the KaSSR Ministry of Nonferrous Metallurgy, we are to achieve a labor productivity growth of 20.2 percent. Toward this objective we have specified a broad range of technical and organizational measures. Following are the most important of these measures.

First of all, we shall reorganize the main titanium production process operations and bring new facilities on-stream. Second, we shall design an electrolytic cell for a carnallite feeding arrangement with excellent performance figures, and we shall complete the adoption of electrolytic cells with an additional cathode in place of a middle wall. In 1984 we shall put into operation a closed-cycle circulating water supply station. The work force has already begun carrying out these measures.

We are counting heavily on the brigade form of organization of labor and labor compensation. By the end of the five-year plan we intend to change over to this advanced method 85 percent of industrial production personnel.

We shall incorporate the norm-plan system in all brigades, a system which provides worker incentive to do the job with fewer people. Considerable attention will be devoted to scientific organization of labor and improvement of economic accountability.

One major reserve potential for accelerating the pace of labor productivity growth is further mechanization and automation of heavy manual operations. Last year we drafted a comprehensive program of mechanization. The first stage of its implementation has now been completed: we have documented manual jobs and specified measures to achieve a sharp reduction in their number.

The resolutions of the 26th CPSU Congress have evoked in the combine's work force a new surge of productive energy and a desire to build further upon achieved successes. The main goal sought by each and every employee is to boost labor productivity.

3024
CSO: 1842/32

UDC 669.295:620.186.1

INCOMMENSURABLE STRUCTURES IN TITANIUM ALLOYS

Sverdlovsk FIZIKA METALLOV I METALLOVEDENIYE in Russian Vol 52, No 1, Jul 81 (manuscript received 30 Apr 80) pp 119-127

D'YAKONOVA, N. B., LYASOTSKIY, I. V., Institute of Metallography and Metal Physics, Central Scientific Research Institute of Ferrous Metallurgy imeni I. P. Bardin

[Abstract] The purpose of this work was to determine the specifics of the structure in alloys with large shift of diffuse scattering maxima with slight expansion. The diffuse scattering of electrons in binary alloys of Ti with 24 at .% V, Cr, Mn and Fe was studied since δ increases most rapidly with electron concentration in alloys in which the components are in the same period. The intensity of diffuse scattering of x-rays was measured near second order maxima and first order maxima in the alloy with 24 at .% Mn. The diffraction effects in this alloy are explained by the use of a model of the structure constructed from identical configurations of displaced atoms, in the placement of which there is long-range order which is retained within the limits of small domains. This model for alloys with large shift of diffuse scattering maxima is similar to an earlier model with unshifted diffuse scattering maxima. Both models conserve long range order over comparatively long distances with disordered placement of close configuration. Figures 2; references 16: 6 Russian, 10 Western.
[2-6508]

UDC 669.295'71'292:539.216.2:539.382.4

MECHANICAL PROPERTIES OF VT6 FOIL OBTAINED BY VACUUM DEPOSITION

Sverdlovsk FIZIKA METALLOV I METALLOVEDENIYE in Russian Vol 52, No 1, Jul 81 (manuscript received 4 Oct 78, final version 24 Sep 80) pp 217-220

ULANOVSKIY, Ya. B., ZHIL'TSOV, Ye. S., ZHURAVEL', A. P. and YEGOROVA, G. I., All-Union Institute of Light Alloys

[Abstract] The purpose of this work was to study the mechanical properties of foil made of high strength VT6 titanium alloy (Ti-6Al-4V) obtained by vacuum deposition. In the process of condensation the substrate was heated to 500-1020°C. The thickness of the foil was 10 to 35 μm. The mechanical properties and chemical composition were determined. It was found that the content of aluminum and vanadium over the length and width of the foil corresponds to the fields of tolerance for their content in VT6 alloy. As the substrate temperature was increased from 550 to 930°C the relative elongation increased from 0.5 to 10.0%. Further increases in substrate temperature caused a decrease in relative elongation to 5.4%. The results obtained indicate the following hypothesis concerning the nature of change

of mechanical properties of foil made of dissimilar metals and alloys obtained by vacuum deposition. As the substrate temperature rises (beginning at a temperature below the beginning of recrystallization), which is accompanied by a transition in the structure to a more equilibrium state and a decrease in the influence of internal stresses, the plastic properties of the foil increase, while the strength properties decrease. With further increases in temperature as grain size increases to a size comparable to the thickness of the foil, the plastic properties of the foil decrease. At substrate temperatures corresponding to the temperature of phase conversions the nature of variation in mechanical properties of the foil also changes, becoming similar to the behavior of mechanical properties of massive materials of the same chemical composition but produced by traditional methods. Figures 3; references 10: 9 Russian, 1 Western.
[2-6508]

UDC 621.762

EFFECTIVENESS OF MAGNESIUM AND SODIUM THERMAL METHODS OF PRODUCING TITANIUM

Kiev POROSHKOVAYA METALLURGIYA in Russian No 8, Aug 81 (manuscript received after revision 22 Jan 81) pp 97-99

SKORODUMOV, V. A., GULYAKIN, A. I. and ABRAMOV, D. S., Berezniki Branch, All-Union Scientific Research and Planning Institute of Titanium

[Abstract] The economic effectiveness of sodium and magnesium thermal systems for production of titanium and the desirability of organizing a domestic sodium thermal titanium production capacity are studied. The two processes are comparatively analyzed on the basis of factual (planned and pilot-scale) data produced by enterprises and the Institute of Titanium on the production of titanium, magnesium and sodium. Technical and economic calculations demonstrated that the cost of production of titanium by the sodium thermal system is slightly lower than by the magnesium thermal system, but the production process consumes more energy, as a result of the high energy consumption of the production of sodium and its almost doubled consumption per ton of titanium in comparison to that of magnesium. However, the sodium is environmentally advantageous. Sodium thermal plants also require less capital investment. Sodium thermal plants should therefore be constructed for production of parts by powder metallurgical methods; magnesium thermal production must be given preference for industries using large titanium parts. References 7 Russian.
[179-6508]

UDC 620.186.5:669.295

PROCESS OF STRUCTURAL RECRYSTALLIZATION OF DEFORMED Ti-6Al-1Mo-1V ALLOY

Minsk DOKLADY AKADEMII NAUK BSSR in Russian Vol 25, No 10, Oct 81 (manuscript received 13 Apr 81) pp 907-910

BODYAKO, M. N., corresponding member, Belorussian Academy of Sciences, GORDIYENKO, A. I. and PONOMARENKO, I. Yu., Institute of Physics and Technology, Belorussian Academy of Sciences

[Abstract] A study is made of the process of structural recrystallization of Ti-6Al-1Mo-1V alloy upon isothermal and rapid continuous heating. Studies were performed using plates measuring 4 x 10 x 70 mm in the initial state and after rolling in the α+β area at 900°C at 30, 50 and 70% compression. The specimens were heated at 10, 25, 100 and 300°C/sec to 800-1300°C with subsequent cooling in water. For comparison, furnace heating with isothermal holding for 30 minutes was also performed. High temperature deformation in the β area had virtually no effect on reducing the grain size in the cast structure, merely changing the polyhedral grain shape (d=15-20 mm) to an extended fibrous shape. The degree of recrystallization was not over 1%. Upon cooling in air after rolling, a plate-like structure was formed within the extended β grains as a result of β→α transformation. The process of structural recrystallization occurs completely in the β area in the stage of recrystallization. By the completion of the process the grain size reaches 500-600 μm. The data were used to construct diagrams of structural recrystallization of the alloy for various heating rates, indicating the relationship of grain size to the degree of deformation and temperature of heating. Figures 2; references 3 Russian.
[26-6508]

UDC 620.179.14

VARIATION IN MAGNETIC SUSCEPTIBILITY DURING AGING OF β-TITANIUM ALLOYS CONTAINING MANGANESE, VANADIUM AND MOLYBDENUM

Sverdlovsk DEFEKTOSKOPIYA in Russian No 9, Sep 81 (manuscript received 15 Dec 80, in final form 20 Feb 81) pp 43-48

MIKHEYLV, M. N., BELENKOVA, M. M., VITKALOVA, R. N. and YELKINA, O. A., Institute of Metal Physics, Urals Scientific Center, USSR Academy of Sciences

[Abstract] Results are presented from studies of the magnetic susceptibility of three β-titanium alloys (wt.%): Ti-6.5 mn, Ti-19V and Ti 3 Mo-8 V in the hardened and aged states. The magnetic properties of the alloys are compared with microstructural changes studied by diffraction electron microscopy. The electron microscope studies show that the hardened Ti-6.5 Mn and Ti-19 V alloys have an unstable BCC structure. It is found that a decrease in magnetic susceptibility is correlated with appearance of the isothermal ω phase in the alloy. The magnetic susceptibility changes in a complex manner as a function of aging temperature in

the 250-600°C interval. A significant decrease in magnetic susceptibility of specimens of all of the alloys studied is observed in the temperature interval of intensive ω phase formation. When the α phase appears in the structure the susceptibility increases. Figures 7; references 9: 5 Russian, 4 Western.
[31-6508]

UDC 669.295'71+669.295'787:669-172"539.379.4

MORPHOLOGY AND NATURE OF DEVELOPMENT OF SLIPPING BANDS IN TITANIUM ALLOY SINGLE CRYSTALS

Sverdlovsk FIZIKA METALLOV I METALLOVEDENIYE in Russian Vol 52, No 2, Aug 81 (manuscript received 11 Jun 80) pp 391-398

KOVALEVA, V. N., MOSKALENKO, V. A. and STARTSEV, V. I., Physical-Technological Institute of Low Temperatures, Ukrainian Academy of Sciences

[Abstract] Single crystals of binary alloys of titanium with 0.1 and 0.6 at .% O and 5.3 at .% Al were studied in experiments on compression at $7 \cdot 10^{-4}$ s^{-1} in the 4.2-423°K temperature interval. The specimens had hexagonal close-packed lattice. The interval of thermally activated plastic deformation can be divided into two areas based on the morphology and nature of development of slipping bands in the alloys studied. Experimental results showed that at low temperatures the wedge-shaped slipping band arising at the boundary is parallel to the Burgers vector, than propagates in the <0001> direction perpendicular to the Burgers vector. The leading edge of the band is parallel to the Burgers vector, formed by helical dislocations. The quantitative parameters of the slipping bands found and particularly the fact that the linear density of superficial traces of slipping is proportional to deformation mean that the contribution of each band to the total deformation is approximately constant. These results cannot be satisfactorily explained using the generally accepted theory, since the alloying of titanium with aluminum decreases the energy of packing defects in densely packed planes, which should hinder the process of transverse slipping. Figures 5; references 11: 2 Russian, 9 Western.
[12-6508]

UDC 669.2

PROPERTIES OF VARIETIES OF SPONGE TITANIUM ENRICHED WITH VARIOUS ADMIXTURES

Ordzhonikidze IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: TSVETNAYA METALLURGIYA in Russian No 3, May-Jun 81 (manuscript received 26 May 80) pp 37-40

LIKHTERMAN, V. A., SHIRYAYEV, R. Ye., BELOVA, A. N., POZDNYAKOV, A. N. and BUGALEVICH, G. V., Leningrad Mining Institute, Department of Metallurgy of Light and Rare Metals

[Abstract] One of the most important problems in the production of sponge titanium is the need to produce homogeneous batches. The authors studied the contrast of the chemical and phase compositions of technically pure sponge titanium and lumps enriched with admixtures to determine the possibility of using new methods of sorting and the influence of various defects on the quality of the metal produced. The phase composition of the surface layer of the defective sponge titanium was studied by x-ray diffraction. The results of the x-ray analysis agreed with standard chemical analysis. It was found that unconditioned varieties of sponge titanium contain several different admixtures, the content of which is regulated by the state standards. This requires that various physical methods such as photometry, activation and absorption analysis be used for defectoscopy. Burnt sponge titanium has the greatest influence on the quality of titanium ingots. Figures 1; references 7 Russian.
[178-6508]

UDC 539.4:621.791:669.295

LOW-CYCLE FATIGUE OF WELDED JOINTS IN AT3 TITANIUM ALLOY

Kiev PROBLEMY PROCHNOSTI in Russian No 8, Aug 81 (manuscript received 27 Jun 79) pp 13-15

KUTEPOV, S. M., PLESHAKOVA, T. S. and RACHKOV, V. M., Moscow

[Abstract] A study is made of the low-cycle fatigue of welded joints of various types, as well as the influence of welding defects on joint strength in AT3 titanium alloy. The studies were performed on annealed sheets 6.0 and 10.0 mm thick. The specimens were cut from a sheet in the direction across the rolling direction. The results showed that the Lendger equation can be used to calculate the low-cycle fatigue strength of welded structures of AT3 alloy. However, due to the significant spread of durability of welded joints, the safety factors should be higher than those used for steel structures. Figures 2; references 10 Russian.
[3-6508]

UDC 669.295.017.621.78

PRODUCTION OF STRUCTURAL STANDARDS OF VT16 ALLOY

Minsk IZVESTIYA AKADEMII NAUK BSSR: SERIYA FIZIKO-TEKHNICHESKIKH NAUK in Russian No 3, Jul-Sep 81 (manuscript received 22 Oct 79) pp 13-16

BODYAKO, M. N., GORDIYENKO, A. I., SHIPKO, A. A. and KOSARIN, A. G., Physico-Technical Institute, Belorussian Academy of Sciences

[Abstract] The kinetics of grain growth of VT16 alloy were studied during rapid continuous heating and heating with brief isothermal holding in order to determine heat treatment conditions allowing the production of controlled uniform fine grain structure. The specimens were heated by electric contact at 10, 25 and 100°C/sec and in a furnace to 700-1200°C at 50°C intervals. The heating temperature and rate are the most important parameters determining the growth of β grains. The lower the speed and the higher the temperature, the larger the end grain size. A table is presented showing the grain sizes produced for various isothermal holding times after heating at 100°C/sec to 900°C. Based on the quantitative regularities of changes in the level of structural reverberation as a function of mean β grain diameter determined, two intervals are then determined for testing of VT16 alloy bars: 10 MHz for evaluation of structures with 10-70 μm grain size; and 5 MHz for evaluation of structures with 30-100 μm grain size. Figures 3; references 2 Russian.
[16A-6508]

UDC 669.295-12:548.735.6

TEXTURE FORMATION UPON RECRYSTALLIZATION OF VT6S TITANIUM ALLOY DEFORMED AT ELEVATED TEMPERATURES

Moscow IZVESTIYA AKADEMII NAUK SSSR: METALLY in Russian No 5, Sep-Oct 81 (manuscript received 6 May 80) pp 126-128

ADAMESKU, R. A., KOCHEGAROVA, G. B. and GEL'D, P. V., Sverdlovsk

[Abstract] Results are presented from a study of the influence of temperature and degree of deformation on processes of texture formation during recrystallization of VT6S alloy. Specimens of this metal 12 mm thick were rolled at 730, 780 and 830°C at varying degrees of compression (25, 50 and 70%). The specimens were vacuum annealed at 50°C above the temperature at which recrystallization begins for various periods of time, then studied by x-ray diffraction in copper radiation with defocusing. The texture was studied by a reflection x-ray method in a diffractometer. The primary role in texture formation during recrystallization of this alloy belongs to oriented grain formation, as a result of which the deformation and recrystallization texture coincide. Rolling at 730 to 830°C was found to stabilize the polygonized structure, hindering the development of recrystallization processes. The texture depends little on duration of annealing, since recrystallization of the hot rolled specimens was slight in any case. Figures 2; references 3 Russian.
[18-6508]

UDC 669.295:537.3

TEMPERATURE VARIATIONS OF CERTAIN PHYSICAL PROPERTIES OF PT-3V TITANIUM ALLOY

Moscow IZVESTIYA AKADEMII NAUK SSSR: METALLY in Russian No 5, Sep-Oct 81 (manuscript received 12 Apr 78) pp 157-160

PELETSKIY, V. E., KUDRYAVTSEV, A. S., AMASOVICH, Ye. S., BEL'SKAYA, E. A., SHUR, B. A. and KUDINOV, S. Ya., Moscow

[Abstract] A melt was studied with the following composition, wt.%: aluminum 4.67, vanadium 2.14, carbon 0.03, silicon 0.03, iron 0.14, nitrogen 0.01, oxygen 0.11, hydrogen 0.003. Specimens were made from a bar produced by forging of a blank heated to 1120-1330°K, with forging terminating at ~1000°K. The bar was then annealed at ~1050°K, and the lower portion of the ($\alpha+\beta$) area cooled in air. The metal had a polyhedral microstructure with α phase grain size ~20-50 μm, with the β phase enriched with β stabilizer and located on the boundaries of the α phase grains. The coefficient of heat conductivity was measured. The radiating capacity was studied calorimetrically with electronic heating. Resistance polytherms were also measured. The resistivity, lorenz function and radiating capacity decrease sharply in the HCP-BCC polymorphous conversion area, while heat conductivity approximately doubles its temperature derivative. Figures 2; references 5: 2 Russian, 3 Western.
[18-6508]

UDC 627.791:669.295:532.6

SURFACE TENSION OF FUSED TITANIUM AND ITS ALLOYS

Kiev AVTOMATICHESKAYA SVARKA in Russian No 8, Aug 81 p 73

PATSKEVICH, I. R., doctor of technical sciences, BOYKO, V. P., engineer, and DEYEV, G. F., candidate of technical sciences

[Abstract] An experimental installation consisting of an electric resistance furnace with a horizontal tubular graphite heater was created to determine the surface tension of fused technical titanium and its industrial alloys. The drop weight method was used to determine the surface tension in argon of VT1-00s, VT6sv, VT14sv and VT20sv wires. The results of the determination are presented in a table, and show that the surface tension of the fused commercial titanium alloys in argon is less than that of technical titanium. This is explained by the presence of such elements as aluminum and zirconium which influence the surface tension. References 4 Russian.
[4-6508]

UDC 621.791.09:621.785

INFLUENCE OF HEAT TREATMENT MODE ON RESIDUAL STRESSES IN WELDED JOINTS IN TECHNICAL TITANIUM

Kiev AVTOMATICHESKAYA SVARKA in Russian No 8, Aug 81 pp 68-69

CHERTOV, I. M., KARPENKO, A. S., candidates of technical sciences, OSTROVOY, A. P., engineer, GUREVICH, S. M., doctor of technical sciences, and ZAMKOV, V. N., candidate of technical sciences

[Abstract] Results are presented from an experimental study of the influence of furnace heat treatment conditions of welded joints of VT1-0 technical titanium on residual stresses. Two series of specimens were studied consisting of two plates 300 x 125 x 3 mm which had been butt welded. The distribution of residual longitudinal stresses in the mid-section of the specimen after welding and after heat treatment were determined by a mechanical tensometer over a 15 mm gauge length. Heat treatment after welding (furnace tempering) did not change the distribution of residual stresses, mainly influencing their magnitude. The heating temperature has the most influence on decreasing stresses. After heat treatment the mechanical properties are as follows: σ_b=460-480 MPa, $\sigma_{0.2}$=380-420 MPa, δ=26-28%, α=180°, i.e., practically the same as the base metal. Figures 2; references 2 Russian.
[4-6508]

UDC 621.791:621.7.044.2

INCREASING BRITTLE FRACTURE RESISTANCE OF WELDED JOINTS TREATED EXPLOSIVELY

Kiev AVTOMATICHESKAYA SVARKA in Russian No 6, Jun 81 pp 70-71

PETUSHKOV, V. G., ZHDANOV, I. M., candidates of technical sciences, and KASATKIN, S. B., engineer

[Abstract] A study is presented of the influence of explosive working on the specifics of generation of brittle fracture from the tip of a transverse notch immitating a crack-like defect. Three types of flat specimens of St3sp steel 9 to 10 mm thick with gauge section 250 x 120 mm and a central 25-mm transverse notch with a radius at the tip of 0.1 mm were studied: base metal specimens, specimens with surfacing on one side performed after notching, and specimens with surfacing which had been explosively treated to reduce residual stresses. At

T=-20°C for all types of specimens σ_n is approximately the same and significantly greater than the yield point of the base metal at this temperature. At T=-40°C, type 2 specimens show a tendency toward brittle fracture. Further decreases in test temperature lead to a great decrease in the net stress for type 2 specimens, but only a slight decrease for the other two types of specimens. This indicates that explosive treatment of the metal adjacent to a crack-like defect increases the brittle fracture resistance practically to the level of the base metal.
Figures 1; references 3 Russian.
[5-6508]

UDC 621.791.72.052:669.715:539.4

FATIGUE RESISTANCE OF AMg6, AMg6N, AND 1201 ALUMINUM ALLOYS AND THEIR JOINTS MADE BY ELECTRON BEAM WELDING

Kiev AVTOMATCHESKAYA SVARKA in Russian No 6, Jun 81 (manuscript received 17 Nov 80, in final version 23 Dec 80) pp 40-42

BONDAREV, A. A., candidate of technical sciences, Ye. O. Paton Electric Welding Institute, Ukrainian Academy of Sciences

[Abstract] The fatigue strength of the base metal and welded joints in AMg6, AMg6N and 1201 alloys made by electron beam welding are determined. AMg6 alloy was used as a 200-mm-diameter tube with 22-mm wall thickness, with welding perpendicular to the direction of the fibers, and as a plate 30 mm thick with welding in the direction of rolling. Plates made from 1201 alloy (16 mm) were welded in the heat treated and artificially aged state in the same direction. The specimens were tested in symmetrical flexure with rotation at 3000 cycles per minute for a maximum of $2 \cdot 10^7$ cycles. The fatigue strength of AMg6 and AMg6N welded joints with no stress concentrators was found to be practically independent of the initial status of the material before welding. The endurance of 1201 joints without stress concentrators was less than that of the other two alloys. The presence of a stress concentrator levels the endurance limits of the three alloys and reduces the characteristics significantly in comparison to smooth specimens.
Figures 2; references 3 Russian.
[5-6508]

UDC 669.539.214

PROCESSES AT GRAIN BOUNDARIES IN SUPERPLASTIC DEFORMATION OF Sn-Bi ALLOYS

Ordzhonikidze IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: TSVETNAYA METALLURGIYA in Russian No 3, May-Jun 81 (manuscript received 3 Mar 80) pp 66-69

VALIYEV, R. Z., KAYBYSHEV, O. A. and TSENEV, N. K., Ufa Aviation Institute, Department of General Technology and Metallurgy

[Abstract] The main mechanism of superplastic deformation is grain boundary slipping, though grain boundary migration is also significant. This article studies the influence of alloying with Bi on the development of grain boundary slipping and migration during superplastic deformation of tin alloys. The results produced are used to study the specifics of the interaction of these processes. The studies performed show that initial grain size in all the materials studied is not completely stable at room temperature, holding leading to some slight grain growth. Grain growth is also observed during superplastic deformation. Grain boundary slipping and grain growth occur simultaneously during superplastic deformation. Usually, the presence of impurities hinders grain boundary slipping. We can therefore assume that the stimulating influence of Bi on the grain boundary slipping rate is related to the influence of boundary migration on the process of slipping. Increase in the content of Bi and particularly the presence of dispersed particles prevents boundary migration, eliminating the inhibiting effect of migration on the development of slipping. Figures 2; references 10: 6 Russian, 4 Western.
[178-6508]

UDC 620.179.14

INSTRUMENT FOR TESTING HARD ALLOY QUALITY

Sverdlovsk DEFEKTOSKOPIYA in Russian No 9, Sep 81 (manuscript received 6 Feb 81) pp 80-85

ZAGAYNOV, A. V. and UL'YANOV, A. I., Institute of Metal Physics, Urals Scientific Center, USSR Academy of Sciences

[Abstract] A description is presented of the KTS-1 instrument developed by the authors for measurement of the absolute value of coercive force of products of hard alloys. The magnetically sensitive element consists of miniature ferroprobe transducers allowing an increase in the base of the ferroprobe gradient meter

while preserving the same operating volume of the magnetic field source, allowing a reduction in measurement error. The principle operates as follows: the object being tested is magnetized by a pulsed magnetic field, then smoothly demagnetized by a field of opposite polarity. The scattering magnetic field from the product is recorded by the ferroprobe. The external magnetic field at which the scattering field from the specimen is equal to 0 is taken equal to the coercive force. Use of the KTS-1 coercimeter in production has significantly reduced the number of cumbersome metallographic studies required to determine the quality of sintered hard alloy products.
[31-6508]

UDC 669.295:541.123.24:548.73

CLOSE LAYER SEPARATION IN TITANIUM-ZIRCONIUM, TITANIUM-HAFNIUM AND ZIRCONIUM-HAFNIUM ALLOYS WITH HCP LATTICE

Sverdlovsk FIZIKA METALLOV I METALLOVEDENIYE in Russian Vol 52, No 2, Aug 81 (manuscript received 24 Dec 79, in final version 16 May 80) pp 357-365

BERNARD, V. B., KATSNEL'SON, A. A., SILONOV, V. M. and KHRUSHCHOV, M. M., Moscow State University imeni M. V. Lomonosov, Institute of Machine Building imeni A. A. Blagonravov, USSR Academy of Science, Moscow

[Abstract] A study is presented of the specifics of the fine atomic structure of the alloys mentioned in the title using the method of diffuse scattering of x-rays. The metals were produced from pure components, melted in an atmosphere of purified helium in an electric arc furnace. The diffractograms taken from the specimens after annealing showed that the alloys consisted of a disordered α-solid solution. It is found that the approximation of regular solutions cannot properly describe the close order in titanium-hafnium and titanium-zirconium alloys. An attempt was therefore made to use the pseudopotential method to describe the close order in these alloys. It is established that there is no long range order in the alloys studied in the area of the α-solid solution, and demonstrated that long term annealing of the alloys at 400°C produces close-order layer separation. It is also established that consideration of second order terms is insufficient for description of the close-order equilibrium by means of the pseudopotential method, and that consideration of third and higher order terms is necessary, corresponding to the introduction of effective noncentral interaction to the ordering energy. Figures 3; references 15: 9 Russian, 6 Western.
[12-6508]

UDC 669-176.001

MODELING OF TEXTURE OF METALS WITH FACE CENTERED CUBIC LATTICE ON ELECTRONIC COMPUTER

Sverdlovsk FIZIKA METALLOV I METALLOVEDENIYE in Russian Vol 52, No 1, Jul 81 (manuscript received 11 Feb 80) pp 112-118

ALEKSANDROV, I. V. and KAYBYSHEV, O. A., Ufa Aviation Institute imeni Ordzhonikidze

[Abstract] The purpose of this work was to implement the theoretical statements of Taylor on a computer under conditions such that various possible mechanisms of texture formation are in effect. Two cartesian coordinate systems were used, one matched with the [100], [010] and [001] crystalline directions, the other with the physical crystal. Successive rotations by the Euler angles are used to match the coordinate systems. A simplex method is then used to solve the equation system derived to model the texture. The results of modeling of textures which arise during plastic deformation in 20 deformation steps are illustrated. The results indicate that the transition from a copper type texture to a brass type texture is caused by appearance of $\{111\}\langle\bar{2}11\rangle$ twinning system. The data agree well with the experimental data. Figures 4; references 7: 1 Russian, 6 Western. [2-6508]

UDC 536.421.15

SUBCRITICAL CRACK GROWTH IN BRITTLE MATERIALS

Moscow FIZIKA I KHIMIYA OBRABOTKI MATERIALOV in Russian No 4, Jul-Aug 81 (manuscript received 4 Sep 80) pp 136-138

BARINOV, S. M., KRASULIN, Yu. L., and GREVTSEV, S. N.

[Abstract] An earlier work stated the assumption that the stage of subcritical crack growth is possible only in materials in which the effective surface energy of fracture increases with an increase in crack length (not considering thermal activation processes). This work presents experimental work intended to test this assumption and to optimize the structure of a porous structural material of refractory compounds in terms of the criterion γ_F/γ_I, where γ_F is the specific effective work of fracture and γ_I is the specific work of initiation of stable subcritical crack growth. Brittle materials were studied: quartz glass, graphite, corundum ceramic and organic glass at room temperature, as well as porous ceramic made of microspheres of stabilized zirconium dioxide at 20-1700°C. It is shown that the relative duration of the stage of subcritical crack growth in brittle materials increases with an increase in the ratio γ_F/γ_I, with an increase in thermal stability of microsphere ceramics observed under the same conditions. Figures 2; references 8: 4 Russian, 4 Western. [180-6508]

HEAT RESISTANCE OF 02KhN40M5GB-ID LOW CARBON CORROSION RESISTANT ALLOY

Moscow METALLOVEDENIYE I TERMICHESKAYA OBRABOTKA METALLOV in Russian No 9, Sep 81 pp 44-45

LEVIN, F. L., USTIMENKO, M. Yu., BYCHKOV, B. V., POKLADOK, V. A. and SAMSONOVA, L. F.

[Abstract] A study was made of the 02KhN40M5GB-ID austenitic alloy, with low summary content of carbon and nitrogen (0.02%). The alloy combines high corrosion resistance and heat resistance over a broad temperature range. Specimens were tested for long-term strength at 600-750°C. It was found that the variation in long-term strength in logarithmic stress-time coordinates is inversely proportional to the time to failure of specimens and is practically linear. Specimens failing after 10,000 hours have long-term strengths of 200 MPa at 600°C, 140 MPa at 650°C and 50 MPa at 750°C and high long-term ductility reduction in area over 70% and relative elongation 36, 47 and 70% at 600, 650 and 750°C, respectively. The alloy thus has good long-term strength, hardens during use at 600°C by a factor of almost 2 and is not subject to early intercrystalline failure in the 600-750°C temperature interval.
[9-6508]

UDC 546.27'171.1

INFLUENCE OF HIGH PRESSURES AND TEMPERATURES ON PYROLYTIC BORON NITRIDE

Moscow IZVESTIYA AKADEMII NAUK SSSR: NEORGANICHESKIYE MATERIALY in Russian Vol 17, No 9, Sep 81 (manuscript received 15 Apr 80) pp 1603-1607

GLADKAYA, I. S., KREMKOVA, G. N. and SLESAREV, V. N., Institute of High Pressure Physics, USSR Academy of Sciences

[Abstract] Results are presented from an x-ray study of the behavior of pyrolytic boron nitride under static pressures of 3.0-9.0 GPa at temperatures of 500 to 2500°K. The experiments were performed in torroidal chambers with a reaction zone volume of 0.15 cm^3 pressure calibrated at room temperature. The x-ray studies of the specimens after application of high pressure and temperatures were performed in filtered copper radiation. An ordered boron nitride structure is characteristically formed in the 3.0-5.0 GPa pressure range. In the 6-9 GPa range a cubic boron nitride phase is observed in the specimens. At 9 GPA over a broad temperature range the specimens contain two phases: CBN, monotonically increasing in quantity with temperature, and boron pyronitride. Figures 4; references 4: 3 Russian, 1 Western.
[11-6508]

UDC 546.882:545.621:546.26

RAPIDLY HARDENED NIOBIUM ALLOYS WITH ALUMINUM AND CARBON

Moscow IZVESTIYA AKADEMII NAUK SSSR: NEORGANICHESKIYE MATERIALY in Russian
Vol 17, No 9, Sep 81 (manuscript received 8 Aug 80) pp 1717-1718

SAVITSKIY, Ye. M., YEFIMOV, Yu. V., RYABTSEV, L. A. and MYASNIKOVA, Ye. A.,
Institute of Metallurgy imeni A. A. Baykov

[Abstract] Extremely rapid cooling from the liquid state by "rolling" in rapidly rotating massive copper rolls of trinary alloys with 0.6-12.7 at .% aluminum and 0.1-3.7 at .% carbon, the critical temperature drops due to an increase in the solubility of the carbon, partial or complete suppression of the peritectic reaction of formation of the superconducting phase, softening of the crystalline structure and an increase in thermal stresses. The critical temperature drop is particularly great if cooling is over 10^6 k/sec. Very rapid cooling of these alloys is accompanied by a great reduction in the size of all structural components, supersaturation and an increase in the quantity of the niobium-based solid solution and a decrease in the quantities of other phases. Annealing to 870°C practically does not change the critical temperature. Figures 1; references 2: 1 Russian, 1 Western.
[11-6508]

BEHAVIOR OF OXIDE FILM ON SINGLE-CRYSTAL SILICON DURING PLASMA APPLICATION OF NICKEL AND ALUMINUM POWDERS

Kishinev ELEKTRONNAYA OBRABOTKA MATERIALOV in Russian No 4, Jul-Aug 81
(manuscript received 1 Jul 80) pp 33-35

KHARLAMOV, Yu. A. and KHASAN, M. S., Voroshilovgrad and Stanford, California

[Abstract] Experimental studies at Stanford University were performed in an induction plasma installation with a 2.5 kW plasmotron, electromagnetic field frequency 2.5-8 MHz, plasma forming gas argon. Spherical powders of aluminum and nickel with mean particle diameters 40 and 100-150 μm were used for atomization. The aluminum particles have an intensive effect on the SiO_2 oxide film. Nickel particles do not damage the SiO_2 film under the same conditions. Since nickel particles do not damage the oxide at 27 m/sec, while aluminum particles do at 8-10 m/sec, it is concluded that damage to the SiO_2 film is not a direct result of the physical and thermal effects of the particles on the substrate. A suggested SiO_2 reduction reaction is presented. The shape of the particles serves as further indication that an exchange reaction occurs between the particles of aluminum and the SiO_2 film. The interaction of aluminum particles with the oxide film has a volumetric nature, and is an exothermic reaction involving reduction of SiO_2. References 6: 5 Russian, 1 Western.
[14-6508]

UDC 629.179.16

USING ACOUSTICAL EMISSIONS TO STUDY FATIGUE DAMAGE IN D16AT THIN SHEET MATERIAL

Kiev PROBLEMY PROCHNOSTI in Russian No 8, Aug 81 (manuscript received 6 Nov 79) pp 15-18

BANOV, M. D., KONYAYEV, Ye. A. and PAVELKO, V. P., Riga

[Abstract] This work presents a study of the regularities of development of acoustical emission during fatigue loading right up to the formation of a visible crack and develops a methodology for calculation of the length of a fatigue crack based on the parameters of acoustical emission. Specimens of D16AT thin sheet material with a lateral notch 11 mm in length and a stress concentrator at the end with a radius of 0.5 mm were tested. The plate thickness was 2.5 mm, gauge section width 100 mm. Sixteen recordings of synchronous AE intensity and cyclical loading were obtained corresponding to various crack lengths of 6.3 to 21 mm. Statistical processing determined the variation in the mean AE intensity as a function of the mean rate of crack growth. The AE method is shown to be reliable and highly accurate in determining the quantitative characteristics of the process of fatigue crack growth in the very earliest stages. Figures 4; references 5: 3 Russian, 2 Western.
[3-6508]

REGULATING DISTRIBUTION OF ANODE TEMPERATURE DURING HEATING IN ELECTROLYTE PLASMA

Kishinev ELEKTRONNAYA OBRABOTKA MATERIALOV in Russian No 4, Jul-Aug 81 (manuscript received 3 Nov 80) pp 40-42

DURADZHI, V. N., POLOTEBNOVA, N. A. and TOVARKOV, A. K., Kishinev

[Abstract] During nitriding of specimens of St10 steel 6 mm in diameter with a depth of immersion of 18 mm, a stream of electrolyte was fed to the upper portion of the electrode at a speed of 0.65 m/sec. The temperature at the bottom and base of the specimen was held at 700°C. Processing time was 4 minutes. Microstructural analysis showed that a continuous nitride zone was created over the entire height of the electrode, was uniform and 30 μm thick. During chemical-thermal treatment in an electrolyte plasma the electrolytes most commonly used are aqueous solutions of ammonium chloride plus aqueous solutions of ammonia or acetone, which have low boiling points. During treatment the volatile components evaporate from the surface of the electrolyte and from the heated areas of the parts. This causes a change in the concentration of the electrolyte during treatment, which in turn causes a change in the surface layer structure. The results of the present study showed that as the quantity of electricity passing through the electrolyte during heating increases, the concentration of ammonia decreases exponentially, particularly sharply at $5 \cdot 10^4$ Cl/l. The concentration of ammonium chloride increases. The concentration of ammonia ions and hydroxyl

ions decreases. The density of the solution increases. The depth of the diffusion layer decreases to 2/3-1/2 thickness after $8 \cdot 10^4$ Cl of electricity have been transmitted. Continued processing causes the thickness to decrease still further. This means that production of homogeneous layers requires that a stream be directed toward the upper portion of the electrode and that the electrode light density be monitored and periodically adjusted. Figures 2; references 8: 7 Russian, 1 Western. [14-6508]

UDC 621.785.53

DIFFUSION CHROME PLATING OF IRON-BASED POWDER ALLOYS

Moscow IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: CHERNAYA METALLURGIYA in Russian No 9, Sep 81 (manuscript received 19 Mar 80) pp 131-134

BOYKO, L. V. and ANDRYUSHECHKIN, V. I., Moscow Institute of Steels and Alloys

[Abstract] Diffusion chrome plating with rapid electric heating was studied on specimens made of reduced PZh2M2 iron and its composites with 0.3 and 0.8% C, as well as specimens of carbonyl type V-3 powder iron. Compact materials of the same composition were saturated in parallel. Chrome plating was performed at 950-1200°C, holding time up to 5 minutes with electric heating, 1 to 3 hours with furnace heating. The medium used consisted of active pastes containing 50% chromium and 50% cryolite in nitrocellulose binder. The kinetics of formation, structure and phase composition of the diffusion layers were studied metallographically, by x-ray phase analysis and by measurement of microhardness. The studies showed that as the temperature rose from 950 to 1250°C, the depth of the chrome layer in the powdered iron increased exponentially. The depth of penetration of the chromium into carbonyl iron, with spherical pores, more pure chemical composition and finer grain, was less than into the reduced iron, with interconnected slit-shaped pores. Increasing temperature and holding time made this difference still clearer. X-ray phase analysis showed that the chrome layer on the sintered iron was an α solid solution of chromium in iron for both heating methods. Rapid chrome plating of powder materials was found to significantly improve overall physical and mechanical properties. Figures 2; references 2 Russian. [28-6508]

UDC 669.017.3

INFLUENCE OF ALLOYING WITH COBALT AND NICKEL ON STABILITY OF PHASES IN Fe-Nb SYSTEM

Moscow IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: CHERNAYA METALLURGIYA in Russian No 9, Sep 81 (manuscript received 26 Sep 80) pp 116-118

VARLI, K. V., DRUZHININA, T. I., D'YAKONOVA, N. P., PIROGOVA, S. Ye. and RUTMAN, A. M., Moscow Institute of Steels and Alloys

[Abstract] An attempt was made to analyze the influence of alloying on the stability of μ phases in systems consisting of the transition metals Fe-Co-Nb and Fe-Ni-Nb. Specimens were melted in an arc furnace with a tungsten electrode over a water cooled copper bottom in an atmosphere of purified argon. The specimens were annealed at 950°C for 600 hours in evacuated ampules, then quenched in water. X-ray structural, microscopic x-ray spectral and metallographic analyses were then employed. As the content of cobalt in the alloys increased the lattice periods of the phase in question decreased. In the system with nickel it was found that the second phase appears in an alloy with 47% Fe, 20% Ni and 33% Nb. The nature of change of the lattice periods of Fe_2Nb as increasing amounts of nickel are added is similar to that for Co. The results indicate that the factor of electron concentration is decisive in its influence on the stability of a number of μ phases formed by the transition metals. Figures 4; references 3: 1 Russian, 2 Western.
[28-6508]

UDC 669.162.12:622.785

ECONOMIC EFFECTIVENESS OF METALLIZATION OF SINTER UNDER PRESSURE

Moscow IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: CHERNAYA METALLURGIYA in Russian No 9, Sep 81 (manuscript received 3 Dec 80) pp 160-163

ZHITNIKOV, O. D., BORISOV, V. M. and BLIZNYUKOV, A. S., Moscow Institute of Steels and Alloys

[Abstract] A technical and economic evaluation of the process of sintering was performed as applicable to the economic conditions of the Kommunarskiy Metallurgical Plant. Processing of the experimental data yielded equations for the production rate of the sintering installation and the degree of metallization of the sinter as a function of excess pressure. The variation in iron content in the sinter with increasing carbon content reaches an extreme at a carbon content of 16 to 18%. The capital investment for the construction of a drum-type sintering machine was assumed to be the same as the capital investment for the construction of a conveyor machine of the same capacity. Systems with high content of fuel in the charge were found to require higher gauge pressure. Considering that the problem of increasing the pressure above 300 kpa is quite difficult, metallization of sinter at P=200-300 kpa with a fuel content of 10-15% is considered preferable. Figures 1; references 3 Russian.
[28-6508]

UDC 534.222

DYNAMIC COMPRESSIBILITY OF METALS AT VARIOUS INITIAL TEMPERATURES

Tbilisi SOOBSHCHENIYA AKADEMII NAUK GRUZINSKOY SSR in Russian Vol 102, No 3, Jun 81 (manuscript received 19 Feb 81) pp 653-655

KABULASHVILI, V. G., Georgian Academy of Sciences, Institute of Rock Mechanics imeni G. A. Tsulukidze

[Abstract] Previous works have derived equations for computation of the pressure at the leading edge of a shock wave, the variation of elastic pressure and elastic energy as function of volume and the total energy at the leading edge of a shock wave. Using these equations, the thermodynamic parameters at the leading edge of a shock wave were computed for various substances at various initial temperatures. As an example, a table presents the parameters for copper. The table shows that if the amplitude of the shock wave is increased, i.e., the compressibility increases, the relative significance of thermal pressure increases. The change in the Gruneisen coefficient along the Hugoniot adiabatic curve is independent of the initial temperature of the material. References 7 Russian.
[20-6508]

UDC 539.235.3:621.315.002

INFLUENCE OF HF DISCHARGE POWER ON POROSITY OF PLASMA CHEMICAL SILICON DIOXIDE FILMS

Minsk IZVESTIYA AKADEMII NAUK BSSR: SERIYA FIZIKO-TEKHNICHESKIKH NAUK in Russian No 3, Jul-Sep 81 (manuscript received 24 Apr 80) pp 23-25

RUMAK, N. V. and PUKHOV, V. I., Physico-Technical Institute, Belorussian Academy of Sciences

[Abstract] A study was made of the influence of the power of an HF plasma discharge at a frequency of 5.28 MHz on the distribution of porosity through the cross section of silicon dioxide films. Specimens were prepared on substrates of KEF-20 silicon with orientation <100>60 mm in diameter. Oxide films 0.15 μm thick were applied by the plasma chemical method from an SiH_4-O_2 mixture at a substrate holder temperature of 423°K after peroxide-ammonia treatment of the substrate. The power of the HF plasma was varied by varying the anode current from 0.40 to 0.55 A with a constant voltage of 2 kV. The plates were then exposed to an etchant in a buffer solution. It was found that the porosity and masking capacity of the films depend on the power of the HF discharge: increasing power causes reduced porosity and increased masking capacity. Figures 1.
[16A-6508]

CSO: 1842 - END -

END OF FICHE DATE FILMED

Dec. 23, 1981